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MOTIVATION AND FUNCTION OF PLAY IN EARLY CHILDHOOD

Miranda Hughes

Thesis submitted for the degree of doctor of philosophy
at the University of Keele, July 1981

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ACKNOWLEDGEMENTS

The research reported in this thesis was initially supervised by the late Dr. Corinne Hutt; her help and support were invaluable. I am also extremely grateful to Professor John Hutt for his advice and criticism during the preparation of the manuscript.

Thanks are due to Alan Dean, Stuart Forrest, Chris Woods and Bill Sollitt for technical assistance; to Viv Edwards and Helen Foy for help in testing and observation in the fantasy play studies (Studies 6 and 7); to Nigel Collins and Ruth Ingram who acted as play tutors in Study 5, and to the staff and children of the various pre-school establishments in North Staffordshire and Leeds who so willingly cooperated in much of the experimental work.

The presentation and typing of the thesis is the work of Mrs. M. Walton; her help has been greatly appreciated.

FOREWORD

My interest in the motivation and function of play in early childhood developed from my acquaintance with Dr. Corinne Hutt's work on exploration and play. I therefore felt greatly privileged when she agreed to act as a supervisor of my Ph.D. research. She was always assiduous in her supervision, but the benefits of working with her extended far beyond the minimal student-supervisor relationship. Corinne was one of those rare people who took such pleasure in her work that she inspired and maintained enthusiasm in those around her. Her criticism was always softened with some very constructive advice, and her own standards of intellectual rigour and sheer application provided an extraordinary example of academic commitment. Her tragic and premature death was a great loss to everyone who knew her, and it cut short the further contribution she would surely have made to psychology.

This thesis cannot but fall short of the standard of excellence which she sought from her graduate students, and it is a matter of great personal regret that she never saw it completed. Nevertheless, I hope that her influence does not go unnoticed in the manner in which the research was executed and reported. The thesis is dedicated to her memory.

ABSTRACT

It is argued that a classification of play which can be systematically related to motivation and function is a prerequisite for empirical studies. 'Arousal' theories have come closest to providing a framework for understanding motivation and function, but the term 'arousal' itself requires careful definition. Definitions of the terms 'play' and 'arousal' are made after review of relevant literature in Chapters 1 and 2.

The behavioural sequences which distinguish different kinds of play are shown to be amenable to quantitative analysis which confirms qualitative behavioural distinctions (Chapters 3 and 4), and to have different functions: ludic play is innovative, whereas exploratory play is more akin to a learning experience (Chapter 5).

Chapters 6,7 and 8 draw attention to analogies between manipulative and symbolic play, and experimental investigations explore the relationship between symbolic play and cognitive abilities. No evidence is found for a unique role of symbolic play in cognitive development.

The validity of arousal theories is specifically tested in three studies reported in Chapter 9. Theoretical predictions suggest that the motivational antecedents of play and day-dreaming will be similar: the physiological correlates of play and day-dreaming are shown to be similar, and to reflect lower states of arousal than are found during exploration and problem-solving.

Finally, a model of play is proposed which attempts to integrate the experimental findings within the terms of motivational systems theory. This permits a classification of play which can be directly related to functional outcomes.

CHAPTER 1

DEFINITIONS AND THEORIES OF CHILDREN'S PLAY

The research to be reported in this thesis was provoked by a general curiosity concerning how children decide what to do (when unconstrained by the instructions of adults) and what the implications of this decision might be in terms of their intellectual and personality development. For example, does the child who is apparently happy to spend every waking hour in fantasy play, grow up at some particular disadvantage relative to the child who disdains such activity entirely? In essence this thesis is therefore concerned with the questions 'Why does a child choose a particular form of play?' and 'What are the functions of different types of play?'. These questions are approached through a consideration of some theories of play described in the psychological literature, and a conceptual framework is developed from these to interpret a series of experimental investigations. Research into children's play has been dogged by the imprecision of the concept of play, and the preliminary review, therefore, largely reflects an attempt to find a behavioural taxonomy of play from which to proceed.

1.1 Early biological and classical theories

In 1898, Karl Groos completed a lengthy and scholarly analysis of "The Play of Man" (English translation, 1901). His book begins with an apologetic introduction: he says that "... I can hardly hope that my classification (of play) will satisfy all demands, but I reassure myself with the reflection that

absolute systematization is and must remain, in the vast majority of cases, a mere logical ideal." Struggling to formulate a definition of play, he finally arrives at the statement "... I must content myself with the term 'natural or inherited impulse' as the basis of my classification". (1901, p.4).

He rejected as inadequate the (then current) theory of Spencer (1858) that surplus energy provides the sole motive for play. Such a theory is dependent upon the premise that an organism is capable of generating a finite level of energy that must be expended. If the demands of the environment do not require the use of all such capacity then a surplus accumulates which is utilised during play. Groos points to the major flaw in this argument - that play often occurs when an organism is tired - and himself argues that two leading principles are implicated in motivating play ..." namely, the discharge of surplus energy and recreation for exhausted powers. They may operate simultaneously" (p.368). He thus sees play as having a possible recuperative function.

In fact, Groos' masterly descriptions of playful behaviour do not warrant his apologia. He is perhaps the first author to acknowledge that it is the inventive nature of play which makes it impossible to encapsulate the full meaning of the word in a brief definition. His sub-divisions of play preempt those of many later authors, as do his ideas concerning the relationship between imaginative play in childhood and subsequent creative ability in adulthood. He recognises play as being both of biological significance (i.e. practice of

skills) and of sociological import (in the reflection and re-statement of cultural norms) yet the prime motivational forces he regards as physiological.

In Groos' book, we see the germs of some later important ideas: (i) that play, although pleasurable, is also useful for the practice and improvement of skills; (ii) that play reflects cultural values; and (iii) that play is motivated by and satisfies physiological needs - "...external effects of pleasurable feelings are accompanied internally by a heightened excitation of the sensory and motor centres of the cerebrum, much like that produced by concentrated attention - a fact which points to the probable explanation of the physiological side of pleasure" (p.31).

The recapitulation theory expressed by Gulick (1898), a contemporary of Groos, seems trite by comparison: "It appears to be not only true that the body rehearses the life of the race: it appears to be true that the mind must do so also, and that the plays of children are the rehearsal of the activities of the race during forgotten ages ... play is the ontogenetic rehearsal of the phylogenetic series." (p.803). Thus the playful behaviour of young mammals is supposed to recapitulate the history of the race. Such a theory fails utterly to explain children's eagerness from an early age to utilise contemporary technology (e.g. toy cars or talking dolls); nor does it indicate why particular aspects of our evolution should not be seen during play. How many children, for example, will chip flints when there is a penknife available? Furthermore, the theory is woefully inadequate in its

failure to consider motivational mechanisms, and, despite its reliance on Darwinian principles, does not suggest why playful behaviour of this type should be adaptive. Hall (1916) reiterated Gulick's thesis, (rejecting the view of Groos as "...partical, superficial and perverse" p.202), but 'recapitulation theory' died a natural death when its deficiencies became increasingly obvious in the context of an era of rapid technological advance.

Groos's (1898) definition of play as natural or inherited impulse was in some ways analogous to that of other authors writing at about the same time. James (1890), for example, regarded all behaviour as being motivated by instinct, and argued that man develops a facility for intellectual decision because he learns to decide which instinct should predominate at any one time. The notion that children's behaviour was predominantly a result of instinct, or impulse, was encapsulated by McDougall (1923) who argued that play was, in some sense, a low priority instinct which was given rein when more essential needs were satisfied.

The tremendous influence of Darwinian theory during this period is very clear: 'adaptive' behaviours were in vogue, and although theorists differed in their interpretation of the adaptive consequences of play, all their definitions rested on the same fundamental premise - namely that play was an instinctive form of behaviour which had some adaptive significance for the species. The main criticism which must be made of these early theories of play is that they lend themselves neither to prediction of behaviour nor to experimental test. Thus any

explanation of play which they afforded was necessarily speculative and insubstantial. The seeds of thought, however, were planted and play came to be regarded as important in learning and personality development long before there was really any substantial theoretical background or empirical evidence for these assumptions.

1.2 Psychoanalytic theories

The most important element in the psychoanalytic conception of children's play is the belief in the capacity of the child to come to terms with traumatic or otherwise significant experiences through their re-enactment during play. Freud suggested that play was any behaviour which disregarded the normal constraints of reality, and that play was primarily motivated by a need to transpose from a generally passive role to an active one; on so doing the normal child is consciously able to mix reality and fantasy. By way of example, Freud described at some length a child who appeared to derive considerable pleasure from repeatedly throwing and retrieving a cotton reel. This activity apparently enabled the child to re-enact symbolically his mother's occasional departure and his pleasure at her return.

Enactment during play is not necessarily confined to actual events - it may also be a playing out of more general concerns. Thus, in Freud's interpretation of 'Little Hans' (Freud, 1909) it is reported that Hans came to terms with his Oedipus complex through symbolic play during which he took the role of a horse (originally ascribed to his father, and the source of phobia) and bit his father. Freud stated the psychoanalytic position

in the following words: "It is clear that in their play children repeat everything that has made a great impression on them in real life, and that in doing so they abreact the strength of the impression and, as one might put it, make themselves master of the situation ... As the child passes over from the passivity of the experience to the activity of the game, he hands on the disagreeable experience to one of his playmates and in this way revenges himself on a substitute." (1920, p.17).

In a review article on Freudian theories of play, Wälder (1934) sought to explain why play should be the vehicle of mastery. He argued that a "repetition compulsion" instinctively led a child to re-enact experiences which he had failed to comprehend, and "functional pleasure" (Bühler's "functionlust" (1930)) was gained through gradual mastery of these experiences. Wälder agreed with Freud that "the antithesis of play is reality, not seriousness", thus play was not necessarily regarded as a joyful experience.

Klein (1955) has been one of the most significant developers of psychotherapy through symbolic play. She used miniature toys - mainly representations of family figures - for projective play, and argued that a game played by a child was comparable to a series of free verbal associations by an adult. The implication of the argument is that the interpretation of a child's play necessarily depends on incidents that precede it, and, therefore, that it is impossible to make generalisations about symbolism. Anna Freud (1946) too, makes the point that play is not necessarily symbolic of anything, and that over-interpretation can be positively harmful.

Erikson is probably the best known neo-Freudian and he has

both revised and expanded on Freud's original theory of play. In Erikson's (1963) schema, play is said to develop first as 'autocosmic' play consisting mainly of sensory explorations. This stage is followed by play in the 'microsphere' which is often solitary and uses toys which are replications of real objects, or are 'manageable' by virtue of their familiarity: this type of play apparently permits the child to "overhaul his ego" (p.213) through mastery both of the toys and the traumas projected on them. At nursery-school age play occurs in the 'macrosphere' (i.e. there is potential involvement with other people) enabling the child to learn the distinctions between mastery of self and mastery of situations involving others. Thus, Erikson proposes that "... the child's play is the infantile form of the human ability to deal with experience by creating model situations and to master reality by experiment and planning." (p.214).

Erikson's description of stages of play was used by Mead and Bateson to interpret some of their Balinese data (reproduced in Schwartzman, 1978). A tiny bird is said to function as an "autocosmic genital symbol", during a sequence which involves a small child sitting at a lamp-post, playing with a bird. Whether such an interpretation is at all enlightening remains to be demonstrated.

The problem with any psychoanalytic position is that each interpretation it permits relies heavily on anecdotal detail and, almost invariably, there is more than one possible interpretation for each observation. The predictive power of psychoanalytic theory is negligible (although Gilmore (1966a) has described a study, which, he claims, offers some support for

the prediction that anxiety-relevant toys are played with by mildly anxious subjects) and this fact, coupled with its untestable interpretations, render it relatively unhelpful in the understanding of children's play. Gilmore's (1966b) theoretical overview concludes that psychoanalytic theories of play are simply a special case of the "more general cathartic theory" which sees play as "reflecting the child's attempt to master situations that are too much for him". In psychoanalytic theory then, play is recognised by the behavioural characteristics of repetition and functional pleasure, and its motivation is derived from the psychic tension inherent in the child's history; functionally, it has the effect of reducing that psychic tension.

1.3 Cognitive theories

In contrast to psychoanalytic theories of play which ascribe an important role to play in personality development, cognitive theories regard play as in some way fundamental to intellectual development. Piaget (1951) took the view that play is an important constituent in the development of intelligence. He argued that every child passes through identifiable stages in development, during each of which there are specific changes in the way the child perceives and thinks about the world. Briefly, during the sensori-motor stage (birth to two years) a child's thinking is limited to the manipulations of sensory objects; the pre-operational stage (2-7 years) is the time when a child acquires a certain facility in symbolic representation of objects; and from there he proceeds to concrete operations (7-11 years), (i.e. comprehension of the stability of concepts such as weight and volume).

This scheme of development is mediated by the twin processes of 'assimilation' and 'accommodation'. 'Assimilation' is a process whereby "every encounter with an environmental object necessarily involves some kind of cognitive structuring (or restructuring) of that object in accord with the nature of the organism's existing intellectual organisation" (Flavell, 1963, p.48) and this acts in consort with 'accommodation' whereby children alter their intellectual organisation to conform with the intransigent realities of objects. Flavell (1963) in his expert interpretation of Piaget's work, states: "In play the primary object is to mold reality to the whim of the organiser, in other words, to assimilate reality to various schemes with little concern for precise accommodation to that reality. Thus, as Piaget put it, in play there is 'primacy of assimilation over accommodation'" (Flavell, 1963, p.65).

Piaget (1951) argues that "primitive play begins by being almost identical with the set of sensori-motor behaviours, of which it is only one pole: that of those behaviours which no longer need new accommodation and are reproduced purely for 'functional pleasure'" (p.87); but during the sensori-motor stage it is often difficult, in fact, to make any sensible distinction between 'assimilation' and 'accommodation' since an infant has such limited schemata. Rosenblatt (1977), for example, observed that "indiscriminate" responses account for 50% of nine-month old infants' responses to novel toys and that there is very little behaviour which acknowledges the function or properties of an object. However, by fifteen months a child will pretend to drink from a cup, or will push a toy car around adding appropriate vocalisations. Even below the age of one year there are marked individual

differences in the manner in which children respond to new objects in their environment: they may be 'lookers' or 'grabbers' (Hendrickson and Hanson, 1977; Hutt, 1979a) and their cognitive schemata will develop accordingly. 'Grabbers' will presumably develop schemata based on somato-sensory feedback, whereas the 'lookers' will be more dependent on visual qualities.

Imitation is regarded by Piaget (1951) as a special category of play which is actually "the continuation of accommodation" (p.86); that is, through imitating the behaviour of an adult (or another child) a child gradually alters his cognitive organisation so that such a behaviour has a meaningful place. Thus, the child imitating a mother's sequence of behaviour (for example, in putting a doll to bed) is accommodating the salient properties of that behavioural sequence.

The balance between assimilation and accommodation is seen by Piaget as the basis for intelligence; and he argues that the processes of development impede the drastic imbalance which leads to the primacy of one function over the other. Thus, although the twin processes contribute to the development of intelligence, pure occurrences of either imitation or play alone diminish as intelligence develops. Sutton-Smith (1966) has criticized this view on the grounds that it fails to account for deliberately ludic behaviour in adults. Indeed, it must be conceded that although Piaget had charted meticulously the stages of development and has argued that children advance through these stages as a result of their striving for equilibrium, he has not really been able to explain why certain types of play behaviour actually persist when adult intellectual functioning has been achieved.

Furthermore, Sutton-Smith (1966) accuses Piaget of failing to appreciate the potentially creative aspects of play behaviour by adhering to an implicit "copyist epistemology". According to Piaget's conception, imitation and play merely mimic the adult world and thereby provide the building blocks for a child's understanding of that world; it is difficult to see a role for extravagant, imaginative games within this framework.

Despite its limitations many workers have conceived studies within the Piagetian framework. Piaget's theory predicts that children will achieve greater mastery over symbolic representation during the pre-operational stage and this has been shown consistently to be the case (e.g. Fein, 1975; Elder and Petersen, 1978). It has therefore been postulated that children's cognitive development will be impeded if they do not engage in symbolic play. Smilansky (1968) was not able to demonstrate any correlation between I.Q. and predilection for symbolic play, but suggested that a relationship might be found between symbolic play and creativity. Lieberman (1977) has summarised a good deal of evidence which links playfulness and creativity; and Dansky (1978) has shown that symbolic play with objects enhances children's ability to think of alternative uses for those objects although other forms of manipulative play do not. Long-term studies such as those of Saltz, Dixon and Johnson (1977) in the U.S., or of Smith and Sydall (1979) in this country, have left unresolved the problem of whether intervention in children's symbolic play serves as useful an educational function as Piagetian theory would predict. The particular theoretical issues and problems which pertain to symbolic play are therefore discussed in detail in Chapter 6.

1.4 Language theories

Garvey (1974, 1977a, b) has paid particular attention to the relationship between play behaviour and language development. The language component of mother-child playful interactions is an important factor in language acquisition (e.g. Lewis and Freedle, 1973; Stern, 1974). The use of language during play facilitates the child's understanding of communication patterns, and once a child has developed some language skills s/he can then play with language. Garvey (1977) proposes that "children's play with language exploits not only the sound, form and meaning of words and sentences but also involves the interactive aspects of conversation and the rules for the interpretation of social acts" (p.75).

Garvey defines play as a "nonliteral orientation toward some resource" (1977, p.76), and reiterates the importance of Bruner's (1972) theoretical statements which stress the fact that playful (or nonliteral) behaviours are specifically 'buffered' from the normal consequences of those behaviours when performed in the literal mode. A child soon learns to use conventional signals that he is 'playing' with language, rather than using it as a means of straightforward communication: for example, his/her speech may be characterized by excessive repetition, incongruous combinations or exaggerated paralinguistic features.

Play with language need not necessarily occur as part of a conversation. Weir (1962) quotes one of her two-year-old son's monologues as he prepared to sleep: "What colour? What colour blanket? What colour mop? What colour glass?"

This is a playful repetition of the phrase 'what colour', and at the same time an exercise in noun substitution. Another transformation which occurred in this child's monologue was that from question to non-question: "Step on the blanket,

Where is Anthony's blanket?" and Hutt (1976, unpublished manuscript) has suggested that this provides a good example of the rehearsal-and-consolidation function of play.

Garvey's examples of play with language illustrate how children will introduce a nonsense syllable or a blatantly outrageous statement to convey a 'play' message; it should be noted though, that children can play with language only when they are proficient with its utilitarian aspects. Thus, for example, the use of puns and riddles occurs only relatively late in childhood.

Garvey makes the point that it is generally possible to demonstrate that some kind of rule has been distorted in a playful performance, and suggests that the study of play ought to provide insights into the nature of the rules that shape the form and uses of language. Goodson and Greenfield (1975) and Greenfield, Nelson and Saltzman (1972) have argued that the structural principles which form the basis of language competence are preceded by the behavioural expression of similar structures in play; and Fein (1975) argues that the ability to transform the role of objects during imaginative play is linked to the understanding of the use of words as symbols for objects. It seems then, that whereas manipulative, object play may have a role in the acquisition of linguistic rules, language play serves to consolidate those rules by repetition and distortion. The relationship between language and play is a symbiotic one, and whilst this relationship is not going to be much explored in this thesis it must remain constantly as a background feature.

1.5 Socialization theories

A number of observational accounts from the anthropological

literature (e.g. Mead, 1963; Bateson and Mead, 1942; Erickson, 1963; Whiting, 1963) have made clear that play varies widely between cultures. An analysis by Roberts and Sutton-Smith (1962) shows that games of chance predominate where children are required to make specific contributions to society and have little opportunity to express their individuality, whereas in societies which value individual achievement of performance games of physical skill predominate. Games of strategy are often seen in societies where there is considerable emphasis on achievement.

What is not entirely clear however is why these patterns arise. Of course the processes which underlie socialisation are manifold, but the interpretative wheel seems to have turned full circle and much influence is now attributed to the adaptive significance of different forms of play. Sutton-Smith (1973) points out that in some cultures the exigencies of existence are such that no play occurs. However, play can make a contribution to the development of culture, through innovation. Schwartzman (1978) has criticised anthropologists who "treat play as if it is a form of social formaldehyde capable of preserving past societies' actions". (p.328).

The influence of socialisation within cultures is perhaps more insidious. Smith (1979) has collected evidence showing that from an early age mothers play differently with male and female children. They encourage the boys to be more active but the girls are talked to more. They also choose different toys for each sex, which confirm sex stereotypes - no evidence of social innovation. Jacklin & Maccoby (1978) have shown that by age 4 boys are bossier than girls in cooperative play situations; even

girls who dominate when with their same sex playmate are apparently submissive when faced with a small boy: Davie et al. (1975) have shown that in addition to sex differences, there are class differences which determine the sort of toys which are chosen for young children.

Socialization theories have applied themselves to the question of why play differs between cultures. They have thus been primarily concerned with games that groups play together, and with cultural universals rather than individual differences. Play is seen as a behaviour very clearly opposed to 'work', but through which cultural traditions are upheld. It is behaviour deliberately engaged in, which, whilst it provides respite from essential activities, is part of a more general framework for cultural development. These theories thus refer to play in its most general sense. It is just because the pressures of socialization are so various that it is difficult to predict how and why an individual child will play alone. Whilst such theories may be helpful in understanding cultural differences, they are less illuminating when trying to ascertain the functional significance of individual play patterns.

1.6 Ethological theories

The theories of play discussed in Sections 1.1 and 1.4 have been concerned primarily with the mentalistic aspects of play, and Section 1.5 was concerned with broad cultural aspects. The emphasis of an ethological approach is on the behavioural aspects, and, in particular, such an approach aspires to a basis classification of play prior to consideration of motivation and function. Beach (1945) for example, listed the outstanding characteristics

of playful behaviours as follows:

- (a) it carries an emotional element of pleasure;
- (b) it is usually characteristic of the immature animal rather than the adult;
- (c) it has no immediate biological result affecting the existence of the individual or species;
- (d) its forms are relatively species specific; and
- (e) its amount, duration, and diversity in a species are related to the phylogenetic position of that species.

It is not easy to see how one might recognise an 'emotional element of pleasure', in, for example, a fish; and Beach (1945) himself alludes to this problem when he records the behaviour of a species of fish which were thought to leap 'playfully' but, by so doing, were in fact dislodging ectoparasites from their skins. Beach concluded "It is apparent that current understanding of play ...and explanations are inadequate" (p.538), and "any serviceable definition of play must be based on a number of predominating characteristics" (p.539).

Only two years later, Schlosberg (1947) argued that Beach's aspirations for an operational definition of play were unrealistic: "...the category 'playful activity' is so loose that it is almost useless for modern psychology." (p.231). But ethologists were not deterred. Welker (1961) for example, emphasised the antic qualities of play in chimpanzees with the following definition: "Play consists of a wide variety of vigorous and spirited activities: those that move the organism or its parts through space such as running, jumping, rolling and somersaulting, pouncing upon and chasing objects or other animals, wrestling and vigorous manipulation of body parts or objects in a

variety of ways. The goals and incentives of vigorous play consist of various patterns of variable or changing stimulation of the sensory surfaces."

Loizos (1966) stated baldly "before causation and function can be discussed to any great effect, it is necessary to consider the actual behaviour that is going to be classed as play." (p.6), and she went on to describe six ways in which the motor patterns of mammals may be altered and elaborated in a playful context:

- (a) the sequence may be re-ordered;
- (b) the individual movements may be exaggerated;
- (c) certain movements may be repeated more often than they usually would be;
- (d) sequences may be fragmented;
- (e) movements may be exaggerated and repeated;
- (f) elements of the sequence may be incomplete.

The incomplete elements of behaviour refer particularly to the non-consummation of, for example, threatening behaviour.

Hutt (1966) described in some detail the behavioural characteristics of children's approaches to a novel toy and subsequent play behaviour. She reported an experiment in which children, who had become accustomed to spending 10-minute periods playing alone in a room (with an adult observer present), were confronted with a novel toy. The toy is illustrated in Figure 1.1: basically, it consisted of a red box (12" x 6" x 6") mounted on four brass legs, with a lever which could activate a bell, a buzzer, and four digital counters. Four experimental conditions were observed, under each of which the novel toy differed in complexity:

- (a) no sound or vision: the bell and buzzer switched off

and counters covered;

- (b) vision only: noises off but counters visible;
- (c) sound only: bell and buzzer on, counters covered;
- (d) sound and vision: noises on, counters visible.

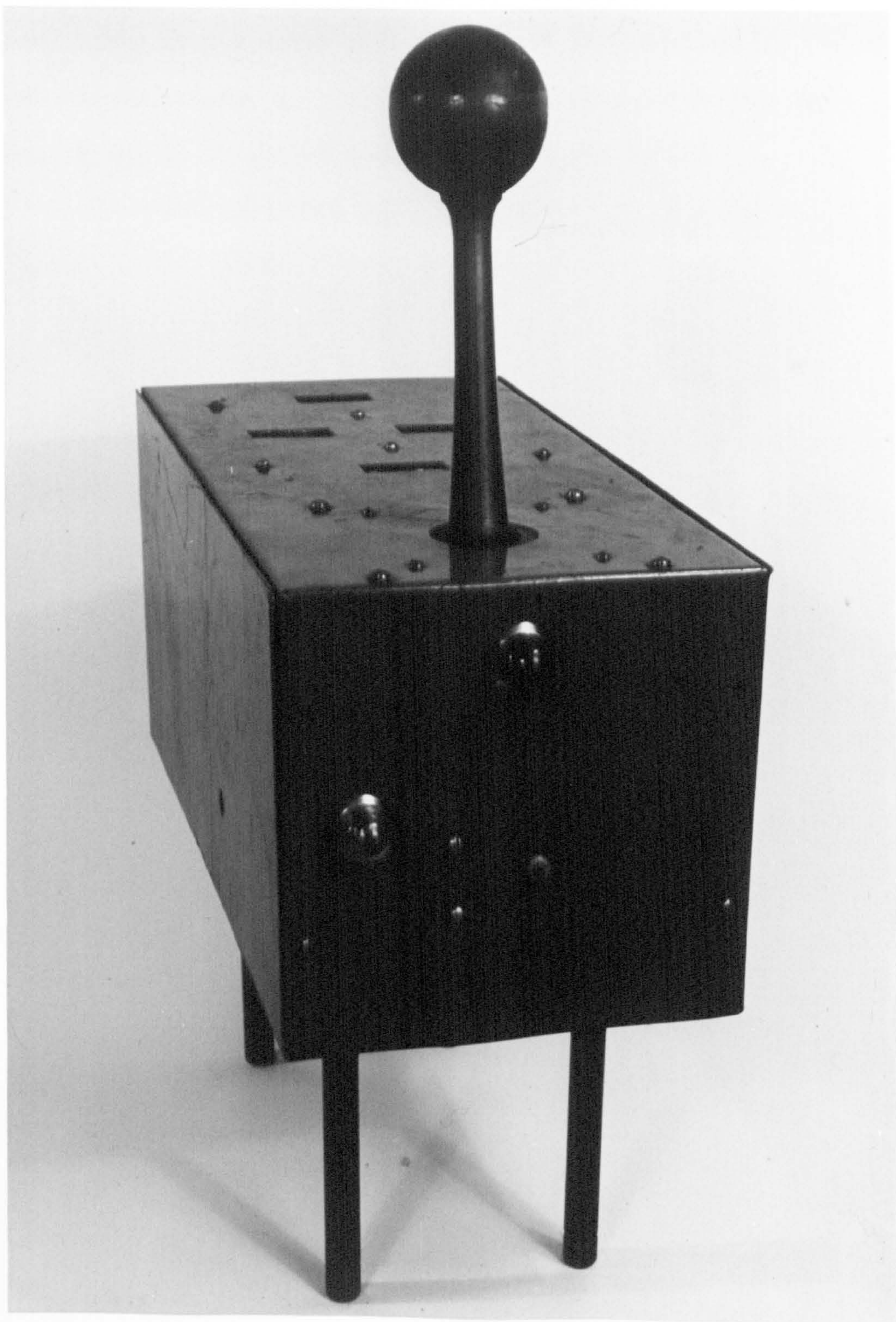


Fig. 1.1 Novel toy used in experiments by Hutt (1966)

In general, when the children entered the room they looked immediately at the novel toy; they would then examine the object manually or inspect it visually while holding the lever, and finally engage in active manipulation of the lever.

The children's behaviour was observed for 10 minutes; they then left the playroom but returned for five subsequent 10-minute sessions at daily intervals. Using the counter readings as an index of manipulation, Hutt found that there was a decrement in this activity over the six sessions and that there was a slower rate of decay with the more complex forms of the toy. In a detailed analysis of conditions (c) and (d), she found it possible to distinguish investigative responses ("those responses that involved visual inspection, and feeling, touching or other manipulations accompanied by visual inspection." (p.69) which decreased over sessions, from other activities involving the object which increased; these latter activities consisted of "repetitive motor movements, manipulations of long duration accompanied by visual inspection of other objects, and a sequence of activities incorporating both the novel object and other toys - in other words a "game"" (p.70). Hutt labelled these two types of behaviour 'exploration' and 'play' respectively and characterised them as showing the changing emphasis from 'what does this object do?' (exploration) to 'what can I do with this object?' (play). In a later paper, Hutt (1970) listed the behavioural characteristics of exploration and play and a summary of these is shown in Table 1.1.

CHARACTERISTICS OF INVESTIGATION AND PLAY, AND MORE GENERALLY OF
SPECIFIC AND DIVERSIVE EXPLORATION (from Hutt 1970)

A.	Investigation	Play
1.	Synchrony of visual and tactile receptors	Desynchrony, or only transient, of receptors
2.	Intent facial expression	Relaxed facial expression
3.	Stereotyped sequence of behavioural elements	Variable and idiosyncratic sequence of elements
4.	Elements of relatively long duration	Elements essentially brief
5.	Elicited by novel stimuli	Never manifest in the presence of novel stimuli
6.	Implicit query: "What does this object do?"	Implicit query: "What can I do with this object?"
7.	Shows linear decrement with time	Is quadratic function of time
B.	Specific exploration	Diversive exploration
1.	Concerns those inspective, investigative responses directed to a particular source of stimulation, i.e. STIMULUS-oriented	Concerns those activities which seem to increase stimulation irrespective of source, i.e. RESPONSE-oriented
2.	Occurs in presence of highly stimulating (by virtue of novelty, complexity etc.) set of environmental factors	Occurs in ABSENCE of specific environmental stimulation
3.	Consists of consummatory response TO stimulus-change	Consists of instrumental response FOR stimulus-change
4.	Extrinsically motivated	Intrinsically motivated
5.	Characterised by response stereotypy	Characterised by response variability or entropy
6.	Occupies superordinate position in motivational hierarchy in that it can inhibit most tissue-preserving activities	Low in motivational hierarchy and can be inhibited by almost any other drive state

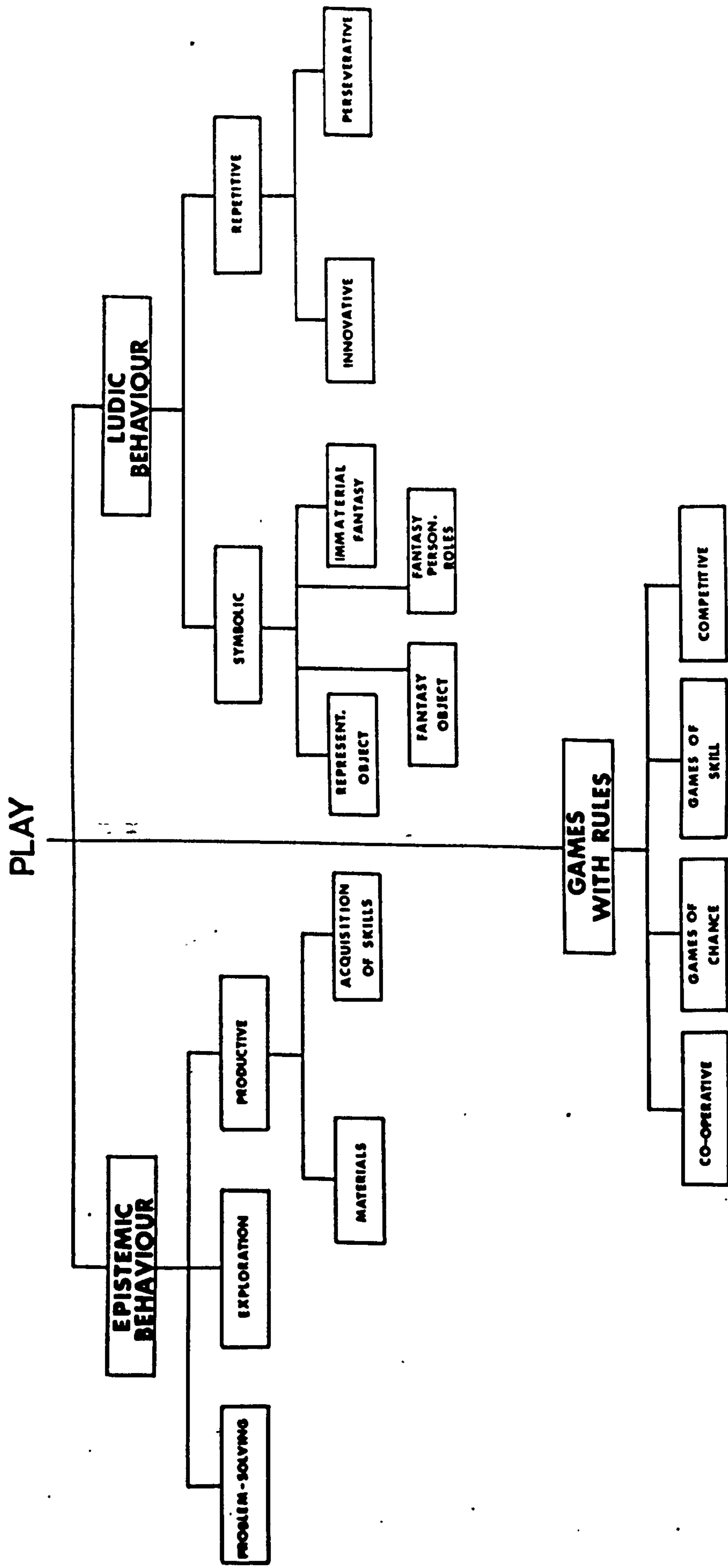
Hutt (1966) suggested that the behavioural differences between exploration and play reflected differences in their psychophysiological substrates. That is, she regarded the behaviour she called 'exploration' as synonymous with what other authors have called 'specific exploration', which reduces uncertainty and hence cortical arousal produced by a novel or

complex situation; her term 'play', she regarded as synonymous with 'diversive exploration' which is an attempt to vary stimulation in order to sustain a certain level of arousal.

However, despite the fact that exploration and play may be readily recognisable under experimental conditions, not all children's activities can be classified within these two categories. For example, is pouring water from one container to another 'play', or is it 'exploration'? Is it simply a behavioural stereotypy? It could be any one of these, depending on the circumstances in which it occurs, and an observer might claim to be able to distinguish the appropriate behavioural label by observation of facial expression (e.g. Blurton-Jones, 1972; Hutt, 1970). Hutt (1979b) suggests some sort of spectrum which includes play at one end and exploration at the other with different categories of play at intermediate points. Such a 'playfulness dimension' would make observational data easier to categorise and should enable the definition of specific types of play which may have direct consequences either for immediately subsequent behaviour or for long term future development.

Hutt's (1979b) taxonomy of play behaviour ranges from 'epistemic' at one extreme to 'ludic' at the other (see Fig. 1.2). She argues that the range of behaviours that can be described in this way are effectively categorised, not only according to 'playfulness' but also reflect arousal states. For example, exploration, which is characterised by the child's look of extreme concentration, is the activity of the 'aroused' child seeking to reduce his arousal level, and is at the epistemic end of the spectrum. Innovative play, on the other hand (such

Figure 1.2 A proposed taxonomy of play (from Hutt, 1979b)



as that described in the Hutt (1966) study) is regarded as 'ludic', and as a stimulus seeking activity when arousal is low. This taxonomy thus provides a behavioural classification of the various activities which are commonly subsumed under the generic term 'play' and thereby facilitates the formulation of specific hypotheses about motivation and function. Nonetheless, 'arousal' is a concept which has itself eluded definition and some attention needs to be paid to the relationship of Hutt's taxonomy to specific psychophysiological mechanisms.

1.7 Arousal theories

Berlyne (1960) argued that diversive exploration is essentially a stimulus seeking activity, in contrast to 'specific' exploration which is a behavioural response to the perception of a stimulus with certain collative properties (e.g. novelty or complexity). He suggested that these behaviours are mediated by physiological arousal mechanisms. Arousal, in this context, is a psychophysiological construct associated with cortical excitation, and reflected in the EEG: thus, high levels of bio-electric excitation (low voltage, fast wave (14-20HZ)) associated with attention are an indication of high arousal; and the slower wave α -rhythm (8-13HZ), characteristic of an organism in a relaxed state, is an indication of lower arousal. Any individual has a characteristic arousal level (also known as arousal tonus) which s/he maintains when awake and alert. Changes in arousal are usually effected as a response to some change of perceptual input for the individual. A novel,

or complex stimulus initially produces an excitatory effect on cortical activity (mediated by the ascending reticular activating system (ARAS)) which is attenuated as the individual habituates to the stimulus. The habituation is thought to occur as the individual categorises or processes the new information.

Fiske and Maddi (1961) argued that stimulus input increases arousal as a function of its "impact" (or arousal potential). Impact can be estimated in terms of its intensity, its meaningfulness, and the extent to which it differs from the preceding stimulation. Put simply, if a stimulus has high arousal potential the cortex is unable immediately to inhibit the effect generated by the same stimulus input in the ARAS. Hebb and Thompson (1954) stated that organisms are motivated to behave in a manner which produces an optimal level of excitation (arousal tonus), and that deviations from the optimal level are increasingly aversive. Berlyne (1960) argued that 'specific' exploration occurred as the optimal behavioural response to reduce arousal which was produced by the perception of a novel stimulus; 'diversive' exploration (ludic behaviour) occurred when arousal was increased due to lack of stimulus input. He resolved this apparent paradox (that high arousal is associated both with high and low stimulus input) by suggesting that when there is nothing of interest (i.e. a lack of stimulus input) in an organism's environment, cortical activation is minimal thus weakening cortico-reticular inhibition and leading to increased (ARAS) arousal.

In experimental work on sensory deprivation, Zubek

(1969) reported that subjects who are deprived of meaningful stimulus input are indeed relatively highly aroused. However, Zubek cites evidence which indicates that an individual's initial physiological response to low stimulus or information input is lowered arousal, and the increase in arousal associated with sensory deprivation does not occur for about 2 hours. It would seem then that diversive exploration is more likely motivated under conditions of low arousal/low information rather than high arousal/low information as Berlyne originally suggested; and that it would serve actually to increase arousal back to tonus level.

As was noted in Section 1.6, Hutt's (1966, 1970, 1979b) work on exploration and play in children relied partly on Berlyne's theoretical formulations and has interesting implications within this framework. For example, in the distinction which Hutt (1979b) made between epistemic and ludic behaviour, it is clear that learning about properties of objects and their inter-relations is subsumed under the 'epistemic' category, which, as has been noted, is assumed to be motivated by states of high arousal and high information input. There is, indeed, some evidence which supports the notion that optimal learning occurs during states of high arousal (Kahneman, 1973). Easterbrook (1959) has argued that a slight increase in arousal has the effect of focusing attention since it limits information-channel capacity, and it is this which would result in the child's apparent concentration during epistemic behaviour. It also has the effect of reducing distractibility.

However, the proponents of arousal theories of motivation have been criticised for their failure to define adequately their premises, and there has been some difficulty in devising experiments which would provide unequivocal support for them. The next chapter therefore reviews some of the implications of arousal theories of play.

1.8 A working classification of play

The combined efforts of behavioural scientists over the past hundred years have failed to yield an absolute definition of play. There seems to be no single characteristic which is common to all forms of play and, at best, we can aspire to identify a set of overlapping characteristics which provide some homogeneity to behaviour which ranges from rattle-shaking in the cradle, through enactment of fantasy roles in early childhood, to the thoroughly intellectual exercise of playing bridge. The listed characteristics described by Beach (1945), Loizos (1966) and Hutt (1970) provide this type of definition. For the purposes of this thesis the term 'play' will be used to cover all intrinsically motivated, non-goal-oriented behaviours; in essence this accords with Hutt's (1979b) taxonomy, and places play of the type described by Beach (1945) and Loizos (1966) within the ludic category of that taxonomy.

CHAPTER 2

A CRITIQUE OF AROUSAL THEORIES

In a review of recent theories of play Ellis (1973) described a very simple physiological arousal system, which he regards as adequate to account for the motivational substrates of play; the system he proposed is essentially similar to that outlined in Chapter 1 and is indeed a sufficient explanatory construct for Berlyne's (1960) classification of exploratory behaviours. However, as Fowles (1980) states so succinctly "As is well known, this model failed the empirical test rather badly...." (p.88). Current views on psychophysiological arousal postulate the existence of at least two interlinked arousal systems (e.g. Lacey, 1967; Routtenberg, 1968), if not three (Fowles, 1980) or even four (Teplov, 1972). These findings necessarily raise the question of whether the parsimony and elegance of a simple arousal model of play can possibly justify adherence to what is seen by many as an outmoded concept. Further conceptual confusion is engendered by a tendency to equate arousal with 'drive' (e.g. Berlyne, 1966) which is another term which has frequently been regarded as misleading. Morgan (1979), for example, accepted that the drive construct is "conceptually economical" but argued "it may be conceptually simpler to postulate a drive than to imagine many independent causal connections: but this does not in any way prove that there is such a thing as drive; or that there are 'drive centres' in the brain" (p.241).

2.1 Neuroanatomical substrates of arousal

The view of Berlyne (1960), subsequently accepted by Ellis (1973), that general activation in the ARAS can be modulated by exploratory behaviour was formulated on what is now recognised as an over-simplified view of the arousal systems of the brain (e.g. Fowles, 1980). Berlyne accepted the prevailing orthodoxy based upon Moruzzi and Magoun's classic paper (Moruzzi and Magoun, 1949) that each sensory system projects, through afferent collaterals, to the ARAS as well as to specific sensory receiving areas of the cortex. The ARAS was thought, in turn, to project diffusely to thalamic, hypothalamic and cortical regions. In fact, the anatomical organisation of the visual and somatosensory systems have proved to be much more complex than this. Experimental investigations have found no evidence for the existence of such collateral input, except in the case of the auditory system. Thompson (1967) cites Brodal's (1957) reports that the visual system projects to the reticular formation via relays from the superior colliculus rather than from axon collaterals of the retino-cortical system, and that there is no collateral input from the medial lemniscus to the ARAS. Despite this, Thompson (1967) suggests that, even if some types of information within a given sensory modality do not project to the ARAS, (which would require the presence of specific multiple synapse, short axon pathways), cortical EEG arousal could be mediated by continuous axon pathways which have been identified. Furthermore, it should be noted, that Sprague, Chambers and Stellar (1961) pointed out some methodological flaws in the original experiments of Moruzzi and Magoun (1949) which are widely quoted as fundamental support for a straightforward relationship

between ARAS and cortical arousal.

A further flaw in Berlyne's (1960) conception of the ARAS was the assumption that it comprised a diffuse network of afferent fibres. In fact, the anatomical organisation is far from diffuse. One set of nuclei projects specifically to the cerebellum, another region is concerned with efferent influences upon the spinal cord and higher brain structures, and projections from sensory pathways tend to be received by specific lateral regions (Thompson, 1967).

Taking some of these difficulties into account, Routtenberg (1968) postulated the existence of two, mutually inhibitory arousal systems. Arousal system 1 (AS1) corresponds roughly with the ARAS system described above, whereas arousal system 2 (AS2) has its major component in the medial forebrain bundle, which contains both ascending and descending components: AS1 is predominantly concerned with behavioural organisation and response, and AS2 is primarily concerned with response to incentive and reward. Routtenberg cites a body of work from the inter-cranial-self-stimulation literature which confirms the existence of separate anatomical substrates for the two systems.

The implications of this anatomical evidence for Berlyne's conceptualisation of the relationship between exploratory behaviour and arousal are not necessarily devastating. Berlyne anticipated that anatomical investigation would enable the identification of specific pathways in the ARAS which would relate directly to levels of cortical arousal; this has not happened, despite the fact that anatomical substrates for the motivation of some responses have been identified (e.g. Routtenberg,

1968, 1978). However, Berlyne's concept of arousal does not depend upon the identification of neuroanatomical evidence - it is sufficient, if not entirely satisfactory, that there should be demonstrable physiological responses to information input and processing. The next sections consider evidence for these.

2.2 Neurophysiological and psychophysiological substrates of arousal

Lacey and Lacey (1970) refer to a "sea of somatic response" (p.205) by which they mean changes in such functions as blood pressure, heart-rate, respiration etc. in response to some exteroceptive stimulus; and they pointed out that the concept commonly used to integrate these phenomena is that of arousal. Various experiments (reviewed by Lacey, 1967) concerned with measuring physiological changes in response to stimuli which could be characterised by novelty, or intensity, or meaningfulness, served to strengthen the acceptance of an identity between sympathetic-like changes (e.g. changes in heart-rate or GSR) and central and behavioural activation. Despite these findings, Lacey (1967) argued that the experimental results which fail to show the expected correlations are strong evidence that "electrocortical arousal, autonomic arousal, and behavioural arousal may be considered to be different forms of arousal, each complex in itself....one cannot easily use one form of arousal as a highly valid index of another...." (p.15).

The dissociation between somatic and behavioural arousal has been well demonstrated using pharmacological tools. For example, Wikler (1952) demonstrated that when a dog was administered atropine, which has the effect of depressing cortical arousal, the animal could still be lively; similarly Bradley

(1958) showed that a cat which was administered both atropine and amphetamine, had a slow wave EEG characteristic of atropine, but was alert and excited. Chlorpromazine, which is used to tranquilise behaviour, does not necessarily inhibit cortical activation (Lacey, 1967). Further, Lacey (1967) cites an experiment by Glasser and Tippet (1965) showing that the pathways mediating postural, respiratory, and cardiovascular activation are functionally separable (at least, in vagotomised, decerebrate cats). Experiments with human subjects (e.g. Mirsky and Cardon, 1962; Malmö, 1966) provide evidence for similar dissociation in normal human subjects. Lacey's view is that psychophysiologicalists and neurophysiologists traditionally worked within a limited set of experimental paradigms in which autonomic, EEG and motor activation all occurred simultaneously. Even so, the degree of correspondence between psychophysiological variables, even if they changed in a similar direction, was never very clear.

Sternbach's classic experiment (Sternbach, 1960) was an attempt to examine the correlation between Wenger's \bar{A} score (which is a weighted, factor-analytically-derived, index of sympathetic activation) and levels of EEG α ; no correlation was found, and Sternbach concluded that "... 'activation' as a concept in emotions cannot refer uniformly to CNS and ANS activity.....an uncritical use of an 'activation' concept of emotions fails to do justice to the differential activities of the nervous system." (p.611).

Research on the dissociation of the psychophysiological arousal indices has given rise to a huge volume of literature,

and a proliferation of sophisticated measurement and analysis techniques. (Gale, 1973, has drawn attention to a sub-species of psychophysiologicalists whom he labels "meccanophiliacs"; such people have been so seduced by the technical wizardry available to their profession that they have lost sight of the psychological issues to which it was intended to apply.) To evaluate the implications of this material for arousal theories of play, the salient question is whether there is any justification at all in using a generic concept of arousal as an explanatory construct.

In Berlyne's (1960) original formulation of the role of arousal in exploratory behaviour, and in Hutt's (1966, 1970, 1979) and Ellis's (1973) development of this theoretical position, it is clear that cortical arousal is regarded as paramount. Hutt, Forrest and Richer (1975) make certain assumptions about the relationship between heart-rate (HR) and cortical arousal, arguing that increased HR arrhythmia is indicative of "a labile and sympathetically dominated autonomic nervous system", and that states of extremely high cortical arousal inhibit the damping of this system; this argument is further developed by Hutt and Hutt (1978) who propose a tentative model of CNS-ANS feedback which is derived from their own data, as well as work from Uvnas (1960), Hilton (1965) and Korner (1971). Their model relies upon the assumption that cortical evaluation of external events governs medullary activation: "either the pressor or depressor centres may be activated, depending upon the nature of the stimulus and the response required" (p.6). However, a review paper by Lacey and Lacey (1978) clearly documents the fact that the mechanisms of a feedback system between heart and brain have not yet been clarified.

Despite this lack of understanding of the relationship between cardiac and cortical activation, there is considerable evidence of consistencies in heart-rate responses to particular classes of event. A complete issue of Ergonomics (1973) was devoted to experimental reports of the suppression of heart-rate variability during information-processing, and an experiment reported by Porges (1972) demonstrated that individuals exhibiting a larger HRV prior to a stimulus onset maintained faster reaction times. These findings have two major implications: first, that an individual actively engaged in a demanding task will have suppressed HRV; and second, that optimal responses to incoming stimuli may be primed by high HRV. Clearly, it could be expected that the task demands associated with suppressed HRV would also be associated with low-voltage, fast-wave EEG activity, but this would not necessarily preclude the dissociation of these parameters in other behavioural states. An examination of the relationship of HRV to exploration and play might therefore shed some further insight into the possible functional dissociation of these behaviours (see Chapters 3 and 8), although the question of their motivation by states of CNS arousal still remains open. The knowledge that different arousal parameters can be independent of one another does not have to detract from the use of such parameters in examining the motivation and function of behaviour, but it is nonetheless desirable to attempt to specify the nature of the relationship between any particular psychophysiological variable and the behaviour under investigation.

2.3 The psychopharmacological substrates of arousal

Within the brain, synaptic contacts are mediated by chemical processes. A nerve impulse arriving at the terminal region of an axon effects the release of a minute amount of 'transmitter substance', this diffuses across the surface of the post-synaptic cell, where it causes an immediate but brief change in the permeability of the cell membrane. This change in membrane permeability can either inhibit or excite the firing of action potentials in the post-synaptic cell. A number of transmitter substances have now been identified (see Table 2.1), and distinctions have been made between the neural pathways that are subserved by them.

Table 2.1. Neurotransmitter substances

<u>Transmitter</u>	<u>Synonym</u>	<u>Abbreviation</u>	<u>Behavioural effect</u>
Acetylcholine	-	ACh	inhibitory
Dopamine	-	DA	excitatory
Gamma aminobutyric acid	-	GABA	
Glutamic acid	-	Glu	
Glycine	-	Gly	
5-Hydroxytryptamine	Serotonin	5-HT	inhibitory
Norepinephrine	Noradrenaline	NE	excitatory

Mawson and Mawson (1977) propose a dual model of neuropharmacological arousal based on the notion of a changing equilibrium between mutually inhibitory systems. They suggest that there are two groups of structures within the brain: one of these elicits

a general, para-sympathetic response accompanied by motor inhibition and cortical synchronisation, the other elicits a sympathetic response accompanied by increased cortical activation. These mechanisms are subserved by specific neuro-transmitters: the sympathetic responses (i.e. behavioural activation) are mediated by noradrenaline (NE) and/or dopamine (DA), whereas behavioural inactivity is generally accompanied by activation of the para-sympathetic nervous system and acetylcholine (ACh) and/or 5-HT systems.

Amphetamine is a drug which stimulates the release of both NE and DA, and one of its most marked behavioural effects is to increase various categories of spontaneous motor behaviour (Iversen and Iversen, 1975). Schiørring (1971) (working with rats) found that increasing doses of amphetamine produce a progressively more intense stimulation of fewer and fewer categories of behaviour. Such behaviour is referred to as behavioural stereotypy; Iversen and Iversen (1975) define this succinctly as a state in which ".....isolated elements of the normal behavioural repertoire, which seem quite inappropriate in the particular environment, are constantly repeated." (p.173). By the selective administration of NE and DA agonists, it has been possible to demonstrate that the DA system in the striatum underlies the expression of behavioural stereotypies whereas both NE and DA are involved in general locomotor activity.

For obvious reasons, data on the effects of neuroleptic drugs on the behaviour of normal human subjects are few. Basically though, any neuroleptic agent will degrade normal behaviour, and it is therefore reasonable to argue that under normal circumstances there is a homeostatic mechanism which maintains a neuro-

chemical state which optimises behavioural responsivity. Mawson and Mawson (1977) argue that a unitary construct of arousal is misleading because it fails to distinguish between arousal in separate neurochemical pathways; they suggest that it would be more helpful to focus attention on oscillation in specific pharmacological and physiological systems.

For play theorists these are hollow arguments. An essential tenet of arousal theories of play is that changes in arousal (which may be either environmentally induced or endogenous) precede behaviours which serve to restore an arousal tonus. It is possible that an improved classification and description of play behaviour might ultimately enable the linking of specific types of play with specific neurochemical changes. The relationship between DA and stereotypy is a step in this direction.

2.4 Arousal as rate of information processing

Delius (1970) suggested that if the nervous system is regarded primarily as an information processing system, then the arousal concept can be "more meaningfully and precisely specified" (p.175) and arousal could be measured in terms of elementary, logical decisions per unit time. He cited some experimental work (for example, Berlyne and McDonnell, 1965; Kahneman and Beatty, 1966) in support of this position, showing that increasing EEG arousal correlates well with increasing information processing. Delius conceded that the autonomic symptoms of arousal cannot easily be accommodated within his model, but argued that autonomic responses are mainly required to distribute metabolic energy and are thus

unreliable indices of CNS arousal in behaviour involving a high rate of information processing but a low level of motor activity. Andrew (1974) documented some further difficulties of Delius's position: it excludes anticipatory arousal states (during which a subject is waiting for a particular stimulus to which he will give a particular response); it creates a paradox (a subject could be examining stimuli and making decisions, but still be in a state of drowsiness); and, in practice, rate of information processing is not easily measured. These are valid criticisms if it is regarded as of primary importance that Delius's arousal measures should correlate closely with those of, say, Lacey (1967) (measures which themselves do not necessarily inter-correlate). However, an equally important issue is whether an information-related measure of arousal is a more useful explanatory concept in behaviour than a purely physiological one.

Delius (1970) argued that the channel capacity (that is, information processing potential) of the nervous system depends on whether it is predominantly engaged in metabolic recovery or in information processing. The metabolic and processing modes are behaviourally characterised as sleep and wakefulness (respectively), but "they can be overridden when certain stimuli impinge on the animal, causing the recovery function to be postponed and the channel capacity to be expanded.....Stimuli therefore may have a dual effect, opening up channel capacity and causing an increase in the processing rate." (p.177). The crux of Delius's argument is that the CNS exerts a control over its information intake (for example, by selective attention)

so as to operate within its optimal capacity at any given time. Behavioural evidence for such a mechanism comes from studies which show that subjects are able to suppress excessive information in order to concentrate on a particular aspect of input (Broadbent, 1965). In a situation where an organism is "informationally undertaxed" information acquisition potential is being wasted; this is unadaptive, and the organism has behavioural strategies which avoid this state (for example, exploratory behaviour, or the retrieval and handling of stored information). The behavioural mechanisms of regulating information processing have an adaptive importance which is self-evident, and Delius argued that his model of information processing regulation closely matches the concept of arousal homeostasis (Berlyne, 1960; Hutt, Hutt, Lee and Ounsted, 1964). By focussing on information processing however, Delius succeeded in drawing attention to the biological importance of a homeostatic mechanism which is not constrained by our limited knowledge of physiological factors. Andrew's (1974) criticisms seem of less consequence when the physiological limitations of Delius's model are thus reduced in importance.

The parallel between information regulation and arousal homeostasis is quite consistent with arousal theories of play and exploration. 'Specific' exploration entails the processing of information from a novel stimulus and is associated with a high level of arousal at stimulus presentation. Arousal is gradually reduced through appropriate behavioural strategy, and processing of the stimulus properties. 'Diversive' exploration (play) is the behavioural mechanism which maintains optimal

information processing in an organism which is "informationally undertaxed" (that is, in a state of low arousal).

2.5 Arousal as an explanatory concept

Sections 1, 2 and 3 have commented briefly on the reasons why a one process physiological model of arousal is inadequate. The term arousal has been used to refer to activation in the para-sympathetic and sympathetic components of the ANS, and to cortical neuroanatomical and neuropharmacological pathways; the relationship between all these systems remains uncertain. In Section 4, it was suggested that whilst the term 'arousal' clearly must be subserved by physiological mechanisms of some kind, the lack of precise identification of these mechanisms does not necessarily detract from its explanatory value at a behavioural level. In using the term arousal as an explanatory construct in childhood play behaviour, this thesis is primarily concerned with the cortical (rather than autonomic) components, and the way in which these may affect information processing capacity. Since heart-rate-variability (HRV) has been shown to be a sensitive measure of information load (and it is easier to measure than EEG activity) HRV is a valid measure of arousal seen in these terms, (Appendix E).

Throughout this thesis, then, the term 'arousal' is used to refer to presumed physiological activity which varies as a function both of environmental (stimulus) demands and individual differences. It is acknowledged that the term is used as a hypothetical construct, but its value in enabling the functional classification of behaviour (Delius, 1970) or an understanding of the causation of behaviour (Hinde, 1970; Andrew,

1974) is such that its continued use may be justifiable.

Hutt's taxonomy of play (Hutt, 1979b) which was illustrated in Chapter 1 (Figure 1.2) represents an attempt to make a functional classification of children's play which is related to arousal states. She argues that during early childhood the pressures of survival are mainly dealt with by caretaking adults, thus relieving the child of the burden of extrinsic demands. Much of children's behaviour is therefore intrinsically motivated to maintain arousal tonus and can be broadly categorised as 'play'. Individual differences in the way children choose to behave stem both from pre-experience and endogenous arousal. The autistic child, who is regarded as chronically hyper-aroused (Hutt and Hutt, 1970b), behaves in a manner which both minimizes the input of novel information and effects a reduction in arousal. Typically, this behaviour is stereotyped rocking movement or head-banging, but persistent gaze aversion is another behaviour characteristic of autistic children which reduces information processing demands. Curiously, Hutt has subsumed "perseverative" behaviours under the category of ludic behaviour although her earlier arguments (Hutt et al, 1964; Hutt and Hutt, 1970b; Hutt et al, 1975) would indicate that whereas ludic behaviour is generally associated with low arousal, stereotyped perseverative behaviours are associated with high arousal. It is with this type of behaviour that the information-processing model of arousal is inadequate, and the above example exemplifies the need for a concept of arousal which embraces a feedback system between stimulus demands and endogenous states.

In normal children the introduction of a novel stimulus causes an increase in arousal which is modulated by exploratory behaviour (i.e. relevant information processing); however, in the chronically hyper-aroused child the information-processing requirement of a novel stimulus increases arousal to aversive levels and the child therefore rejects exploration in favour of a behaviour which reduces the level of information input. Certainly, the autistic child's behavioural stereotypies are states of low information processing, but they are not analogous to ludic behaviour which is stimulus seeking. Thus, whilst Delius's (1970) simple model of arousal as rate of information processing is adequate for the organism which responds to new information by processing it, it is not adequate to explain the behaviour of an organism which rejects new information; for this latter case, it is necessary to postulate variable levels of endogenous arousal.

Eysenck (1966) has argued that the basic personality traits which distinguish extraverts and introverts, are a function of their different basal levels of arousal. He suggested that extraverts are typically 'stimulus seeking' because they have relatively low levels of basal arousal, whereas introverts shun novel stimulation because their relatively high levels of arousal enable only limited tolerance of arousal increases. If this is the case, 'introverted' and 'extraverted' children would be expected to show different play preferences in the pre-school. It is common observation that some children are more wary of new toys and games than

others, and our labelling of these children as introvert or extravert will be partly a function of their wariness in these situations. Nevertheless, it is an interesting speculation that their predispositions are mediated by cortical arousal, and a report by Porges, Bohrer, Kerun, Cheung, Franks and Drasgow (1981) confirms the suggestion that children's disruptive (stimulus seeking) behaviour can be moderated by the use of stimulant drugs.

Hutt's uni-dimensional taxonomy of play could usefully be given an orthogonal dimension which distinguished endogenous arousal levels from increases in arousal associated with stimulus properties. This would enable the plotting of motivational isoclines for different types of behaviour. Consider, for example, a child who must make a decision to explore, to play, or to run away when confronted with a novel stimulus; such a decision must be based on a criterion which evaluates initial arousal in relation to the degree of perceived novelty. McFarland (1977, 1978) has suggested that such a criterion is actually shaped by natural selection, and that a tendency to explore a novel object has to be weighed against the danger inherent in a strategy which requires the child to explore anything. A two-dimensional model, derived in part from Hutt's taxonomy, could take into account the interaction between internal state and external events. (This notion will be considered in Chapter 10).

There is clearly an adaptive value in having an innate decision process of this type and the adaptive value of exploratory behaviour is itself important: an organism which

failed to respond to a novel stimulus by processing salient information would inevitably constrain its development. The adaptive significance of ludic activity is less easy to understand; it may be that it serves only to maintain preferred arousal levels, but an alternative hypothesis must be that whilst arousal levels may mediate the behaviour, ludic activity does have other long term consequences (for example, for cognitive development). The experimental work which is to be described in the next chapters examines differences in the structural sequencing of behaviour in exploration and play, and relates the findings to their adaptive significance.

CHAPTER 3

BEHAVIOURAL CONSTRAINT IN EXPLORATION AND PLAY

In Chapter 1, it was stated that the term 'play' would be used as a generic term to describe all intrinsically motivated, non-goal-oriented behaviours, and it was suggested that this classification would subsume a range of behaviours from those which were apparently epistemic to those which were more evidently ludic (i.e. those which had the "antic" qualities referred to by Beach, 1945); this use of the term play is fundamental to this thesis. However, since the experimental study and behavioural analysis to be described in Chapters 3 and 4 are derived mainly from Hutt's (1966, 1970) experiments the terminology of her work is maintained for these two chapters only.

Hutt described a behavioural distinction between exploration and play, which she related to Berlyne's (1960) distinction between 'specific' and 'diversive' exploration, and showed that they differed in many qualitative characteristics. In experiments investigating children's responses to a novel toy (which was presented in an otherwise familiar environment) it was found that children responded with a characteristic exploratory manner; that is, with an intent and serious facial expression, and co-ordination of visual inspection with manual investigation - the implicit query being "what does this object do?" With repeated exposure to the novel toy the children became playful with it, the facial expression became relaxed and the child no longer needed to watch while he manipulated the toy. The implicit

query then became "what can I do with this object?"; the emphasis shifted from inquiry to invention. Furthermore, Hutt (1970) reported that while the behavioural elements of exploration were relatively long and similar in all children, those of play were brief and idiosyncratic.

Exploration is the behavioural pattern through which an organism acquires information about new features in its environment and thereby reduces information conflict (Nunnally and Lemond, 1973). An animal which makes no exploratory responses to novelty, or which has inefficient strategies of exploration, will fail to learn the features of its environment and may therefore adversely affect its prospects of survival and eventual reproduction. On the other hand, an animal which is totally incautious in its exploratory responses will endanger its biological fitness relative to an animal which makes more discriminating responses. Thus, both the mode of decision and the strategy of exploration have survival value: biological fitness will be improved by sound decision criteria and efficient behavioural strategies. McFarland (1976) has argued that behavioural decisions which substantially affect survival may be influenced by innate (genetically determined) mechanisms for which there has been specific natural selection during evolution, and will therefore be consistent within a given species.

The process of natural selection enables us to expect that good, though not necessarily optimal, design principles will pervade the internal organisation of human behaviour (Dawkins, 1976). Since exploratory behaviour has implications for survival which may not obtain in play, it is

to be expected that the former will be organised in a species specific manner. Hutt and Hutt (1970) have suggested that periods of exploratory and playful behaviour could be amenable to an information theory analysis which measures the sequential dependencies between behavioural categories within a sequence. This type of analysis has been used by Altmann (1965) to describe the stochastics of social communication in rhesus monkeys: he argued that sequences of behaviour in which the sequential dependencies between events are high, reflect species-specific biological organisation of that behaviour.

The study to be reported in this chapter is an attempt to describe periods of exploratory and playful behaviour as sequences of events, and thereby to examine Hutt's (1970) assertion that exploration is characterised by "stereotyped sequences of behavioural elements" and "elements of relatively long duration".

Study 1 - The sequential structure of exploration and play

This study attempts (i) to examine whether the biological importance of exploration relative to play is reflected in the stronger sequential organisation of exploration; and (ii) to quantify the different degrees of stereotypy in these two classes of behaviour.

METHOD

Subjects were 15 children aged 3 years 9 months to 5 years 0 months from a University playgroup, and were familiar with the experimenter.

Apparatus was an adaptation of Hutt's (1966) 'novel toy'. It

consisted of a similar red box (12" x 6" x 6") mounted on a white, wooden stool. The different movements of the lever activated a bell, a buzzer and lights; four post-office digital counters, which could be seen by the child, recorded the movement of the lever in each direction. This toy is illustrated below



Procedure followed that described by Hutt (1966). Children were introduced individually to a playroom (9' x 9') in a specially designed caravan, where they spent two introductory 10-minute sessions with five familiar toys, on consecutive days, in the presence of an adult observer. The novel toy was with the other toys in the playroom when the child came for the first experimental session on the third day. Each child spent a total of eight 10-minute sessions in the caravan on consecutive days (except for a break at the weekend), the latter six of which were with the novel toy.

Observations were made using a checklist and recording predominant behaviour during 10-second consecutive time intervals (Appendices A and B). A set of fourteen mutually exclusive behavioural categories was defined, and modified that of an earlier study (Hutt and Hutt, 1970). The ten-second time interval has been found to be the shortest time interval which can be reliably used, and is also appropriate for use in sampling behaviours which have durations as short as 5 seconds (Hayes, Meltzer and Wolf, 1970; Tyler, 1979). All bouts of behaviour not involving the novel object, and exceeding 3 successive time samples (30 secs.) were excluded.

Analysis was based on measures of 'uncertainty' and 'stereotypy' as described by Miller and Frick (1949).

A quantitative index of the predictability of successive events in a sequence depends entirely upon two parameters: the range of alternative responses a subject can make, and the relative frequencies with which these alternatives appear.

A measure of uncertainty (U) of events in a sequence is defined such that it is a monotonic increasing function of the number of alternative behaviours available. That is, U is a logarithmic function of the number of alternatives, and is the expectation of the function $\log_2 p_i$ (where p_i is the probability of event i); it is thus analogous to Shannon and Weaver's (1949) measure of information and is measured in 'bits'. Mathematically it is defined such that

$$U = -\sum_{i=1}^i p_i \log_2 p_i$$

The concept can be extended to compute values of U for sequences within a sequence. For example, to define an uncertainty value for the event [A followed by B], the probability of B given A [$p(B/A)$] is calculated by its substitution as p_i in the above formula. Using this technique, it is possible to derive a value for the reduction in uncertainty when preceding events are known: technically, this is known as taking account of the 'order of approximation' of behavioural events - U at the first order of approximation takes account only of the total possible number of events (in the case of this study, this is 14), the second order of approximation gives values of U if one preceding event is taken into account, and the third order of approximation gives values of U if two preceding events are taken into account.

To compare results from two or more sets of data, Attneave (1959) suggests the use of a simple adaptation of a χ^2 formula. Attneave proved that there is "a very simple relationship between \hat{T} (the estimate of shared information)

and χ^2 (the measure of significance of this estimate), as follows:

$$\begin{aligned}\chi^2 &= 2 (\log_e 2) n \hat{T} \\ &= 1.3863 n \hat{T} \quad " \quad (p.29).\end{aligned}$$

(n = no. of observations in a sequence).

An index of stereotypy (S) can be calculated which can be used as a direct comparison of the relative uncertainty inherent within different sequences (which may contain both different numbers of events, and different sizes of repertoire). This measure is given by the ratio of U to Umax, where Umax is the maximum uncertainty which could obtain given the response repertoire available. Thus, for a range of n behaviours, $U_{\max} = \log_2 n$. The index of behavioural stereotypy is then defined such that

$$S = 1 - \frac{U}{U_{\max}}$$

Hence, a value of S equal to 0.25 would be equivalent to the statement that 25% of responses are determined and the remaining 75% are maximally uncertain.

It is an implicit assumption of analyses of this type that the sequences analysed have the property of ergodicity: that is, the probability laws which characterise a sequence must remain constant for all parts of the sequence. In order to comply with this assumption appropriate periods of behaviour had to be deliberately selected from the observations.

RESULTS

When the children entered the playroom on the first experimental session they usually looked around and quickly

fixated their gaze on the novel toy; thus, either 'watch' or 'visual inspection of object' responses characterise almost all the first entries on the check-lists. As predicted (from Hutt's 1966 study), there was a decrement in specific exploration to the novel object upon repeated exposure and there are therefore fewer data from the sixth session (686 entries on the checklist) than from the first (716 entries). In order to comply with the ergodicity assumption inherent in the analysis, only the first and sixth sessions were analysed because they yielded instances of purely exploratory and purely playful behaviour.

A summary of the observational data from sessions one and six (exploration and play, respectively) is shown in Table 3.1. During exploration six of the behaviour categories were superfluous to the description of behaviour, although during play all the categories were relevant. This reflects the greater behavioural variety during play which is alluded to in many definitions (Miller, 1973). Computation of chi-squared values showed that the recorded frequencies were highly significantly different from random (χ^2 (exp) = 2165, 13df, $p < .001$; χ^2 (play) = 183, 13df, $p < .001$).

The data from Table 3.1 were used to compute uncertainty values for behaviour during exploration and play giving values $U(\text{exp}) = 2.277$ and $U(\text{play}) = 3.654$. These yield stereotypy values of 0.402 and 0.0402 respectively when U_{max} is assumed to be $\log_2 14$. It can however, be argued that $U_{\text{max}}(\text{exp})$ should be regarded as $\log_2 8$, since only eight behaviour categories are actually recorded during session one. Even when

$U_{\max}(\text{exp})$ is assumed to be $\log_2 8$ the stereotypy values remain above those of play (see Figs. 3.1 and 3.2). Uncertainty and stereotypy values were also calculated at second and third orders of approximation and these data are illustrated in Figs. 3.1 and 3.2. The exact values are given in Table 3.2. It should be noted that the conditional uncertainty represents the uncertainty which is added by considering a sequence of events. Thus, the total uncertainty associated with a dyad during exploration is 3.88 bits, which is 1.6 bits greater than the uncertainty associated with a single event; the conditional uncertainty at the second order of approximation is therefore 1.6 bits. Regardless of whether exploration is considered to have fourteen potential categories (E_1) or only eight (E_2), the uncertainty values at orders of approximation greater than zero are equal for E_1 and E_2 since $U = \sum_{i=1}^I p_i \log_2 p_i$

Using Attneave's (1959) adaptation of χ^2 formula, it was possible to calculate whether or not the difference in uncertainty between exploration and play was significant. For the present data, χ^2 is significant at all orders of approximation greater than zero. At orders of approximation one, two and three the values of χ^2 are 83.6, 134.7 and 152, all significant at $p < .001$ with d.f. 1, 2 and 3.

Tables 3.3 and 3.4 show the frequency with which dyadic sequences were observed. Less than a quarter of the possible dyadic combinations were seen during exploration whereas almost two-thirds of them were seen during play. The number

of possible triadic sequences is substantially reduced from the maximum of 2744 when dyadic observations are considered. Thus, during exploration, the number of possible triads becomes 233 and during play 1208. In fact, the number of observed triads during exploration was 104 and during play it was 318. Owing to the small sample size, it is inappropriate to attempt to estimate the significance of these figures but a trend is nonetheless reflected.

It could be argued that these results are due partly to artefact owing to the greater number of categories available during play; i.e. the greater uncertainty evident during play can be altered according to the number of additional behavioural categories chosen. It was therefore decided to effect a reduction in the number of categories under consideration and to consider the implications of doing so for the interpretation of the above findings. The number of categories was reduced simply to two: "highly exploratory" (E) and "other" (N). These were defined on the basis of the data from the checklists and reflected the consensus agreement of the author and a second experienced observer (CH). Evidently, the predominant categories during exploration were visual inspection, touch/finger, and lever; these were regarded as "highly exploratory". Although they also occur during play it was felt that the effects of this overlap would be counterbalanced by other categories which are generally considered playful but do occasionally occur during exploration, e.g. manipulate and phys., run/walk, watch. The results of this analysis are given in Table 3.5. The

question posed remained essentially the same, i.e. are the dyad and triad transitions more predictable during exploration than play? Two-by-two and 2 x 4 contingency tables, for dyad and triad transitions respectively were drawn up for both the exploration and play sessions and χ^2 values were calculated. Clearly, the greater the value of χ^2 , the greater the deviation of the cells in the contingency table was from random. For both dyad and triad transitions in both exploration and play all the χ^2 values were highly significant. Indeed, this was to be expected since one would inevitably find more E recordings during exploration, and more N during play. However, the values for the exploration session were greater than those for play. This analysis therefore confirmed the earlier result that behaviour during play is less stereotyped than during exploration.

DISCUSSION

The qualitative distinction between exploration and play behaviour has been described by several authors (e.g. Berlyne, 1960; Hutt, 1966; 1970; Nunnally and Lemond, 1973), and the temporal characteristics and motivational conditions associated with these behaviours are also said to be distinct (Hutt, 1967; Welker, 1961). Nonetheless, there has remained a tendency to regard exploration as a constituent in the generic category of play (Thorpe, 1963; Bruner et al., 1976). The results described above go further towards emphasising the distinction between these two categories of behaviour by the demonstration of distinctive structural organisation of the sequences; whereas exploration is highly constrained,

play is significantly less stereotyped. The question of whether exploration is characterised by "elements of relatively long duration" (supra) can be answered convincingly by study of Table 3.2 (Frequency of Observed Dyads during Exploration): the values in the diagonal cells are consistently the highest in each row or column (with the exception of element 13 - the "run/walk" category).

The quantification of differences in behavioural structure has long been a topic of considerable interest to behavioural scientists. The "information theory" method of analysis used here seems particularly valuable, because different sequences are not only parsimoniously described but are also amenable to quantitative comparison. The difficulties which it presents lie mainly in the collection of appropriate and sufficient data. In spite of this, Chatfield and Lemon (1970) have indicated that information theory is one of the most valuable tools available in preliminary studies of behavioural sequences. In a more recent paper, Morgan (1976) has suggested that simulated sequences could be developed based on the empirical data. These would effectively supplement the original sequences and make it possible to decide on the significance of the uncertainty.

Dawkins (1976) comments that highly organised behavioural sequences tend to be species-specific and to vary little between individuals within a species; he argues that this suggests that evolutionary pressures have resulted in the selection of species-appropriate organisation or constraints. It is interesting to note that exploration had already been described as varying little between children

(Hutt, 1970); the present analysis provides clear evidence of its degree of constraint. The superiority of 'homo sapiens' stems largely from flexibility in interaction with the environment. This flexibility results as much from a wide repertoire of behavioural elements, as from variability in the organisation of these elements. The more immediate the consequence of behaviour is for survival, the more constrained that behaviour is likely to be. It is for this reason that the exploratory activities of phylogenetically lower mammals have been termed 'instinctive motor patterns' (Schiller, 1957). The structure of play was also perceptively anticipated by Morris (1956) when he remarked that in play "the mechanisms of mutual inhibition and sequential ordering" evident in other drive states are not operational and hence there is less control over their nature and sequence.

Dawkins (1976) takes these arguments yet further to suggest that the organisation of behaviour will be hierarchical since this structure would minimise the number of decisions an animal would need to make whilst in no way limiting the extent of the behavioural repertoire. The next chapter therefore attempts to describe the data from Study 1 in terms of their hierarchical organisation.

TABLE 3.1

FREQUENCY OF BEHAVIOUR DURING EXPLORATION AND PLAY

Frequency of behaviour during <u>exploration:</u>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	TOTAL
	Visual Inspec.	Touch/ finger.	Lever	Hold +toy	Manip. +toy	Manip. fast	Manip. +gest.	Manip. +phys	Manip. +talk	Manip. unconv/	Push /pull	Manip. other	Run walk	Watch other	
	105	93	344	5	0	0	0	16	0	0	0	47	28	78	716
<u>play:</u>	16	13	80	32	63	40	21	57	77	51	21	96	52	69	686

TABLE 3.2

VALUES OF UNCERTAINTY (IN BITS) AND SEQUENTIAL STEREOTYPY
AT DIFFERENT ORDERS OF APPROXIMATION

<u>Order of Approximation</u>		1	2	3
<u>Uncertainty</u>	Exploration	2.28	3.88	5.3
	Play	3.65	6.14	7.91
<u>Stereotypy</u>	E ₁ (14 categories)	.4	.49	.54
	E ₂ (8 categories)	.24	.35	.41
	P	.04	.19	.31
$\hat{T} = U(E_1) - U(P)$ (shared information)		1.37	2.26	2.61
n (mean length of sequences)		44	43	42

TABLE 3.3
FREQUENCY OF OBSERVED DYADS DURING EXPLORATION

Preceding

	Following													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	39	18	34	1									4	2
2	25	37	26										2	2
3	38	33	253	2				3				3	1	10
4				2								1	1	1
5														
6														
7														
8		1	4					11						
9														
10														
11														
12								1				28	7	10
13	1	1	6									3	3	14
14	2	3	15									8	9	35

(42 dyads out of a possible 196)

Number of possible triads = 233)

TABLE 3.4

FREQUENCY OF OBSERVED DYADS DURING PLAY

		Following													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		1	4		4			1	1	1	4				1
	2		3	9					1						
	3	3	7	45	1	5					1	2	1	6	1
	4			5	9	4			2	2	4		1	2	3
	5			3	6	34	4	1	1	3		1	7	2	1
	6	3	1	3	2	4	19	1	3	3				1	
	7		1		1	4	3	4	1	6	1				
	8		1	2	1	4	3	2	32	7	2		1	1	1
	9	4		2	3	4	5	5	12	32	6	2		1	1
	10			1	4		2	2	1	5	20	3	1	11	1
	11				1			2		2	4	8	3	1	
	12				3			1		4	2	5	54	12	12
	13	2		4		2	2	2	1	2	8		10	4	13
	14			2	1				1	7	3		14	10	28

(127 dyads out of a possible 196)

Number of possible triads = 1208

TABLE 3.5

(i) Session 1 (Exploration) Dyad Transitions.

		following	
		E	N
preceding	E	503	30
	N	33	134
$\chi^2 = 395$ (d.f. = 1) $p < .001$			

(ii) Session 6 (Play) Dyad Transitions.

		following	
		E	N
preceding	E	75	26
	N	34	536
$\chi^2 = 294$ (d.f. = 1) $p < .001$			

(iii) Session 1 Triad Transitions.

		following			
		EE	EN	NE	NN
preceding	E	465	32	6	24
	N	29	1	20	107
$\chi^2 = 387$ (d.f. = 3) $p < .001$					

(iv) Session 6 Triad Transitions.

		following			
		EE	EN	NE	NN
preceding	E	51	21	1	31
	N	15	10	24	501
$\chi^2 = 291$ (3 d.f.) $p < .001$					

Figure 3.1 Relation between the order of approximation and the conditional uncertainty of any behavioural event

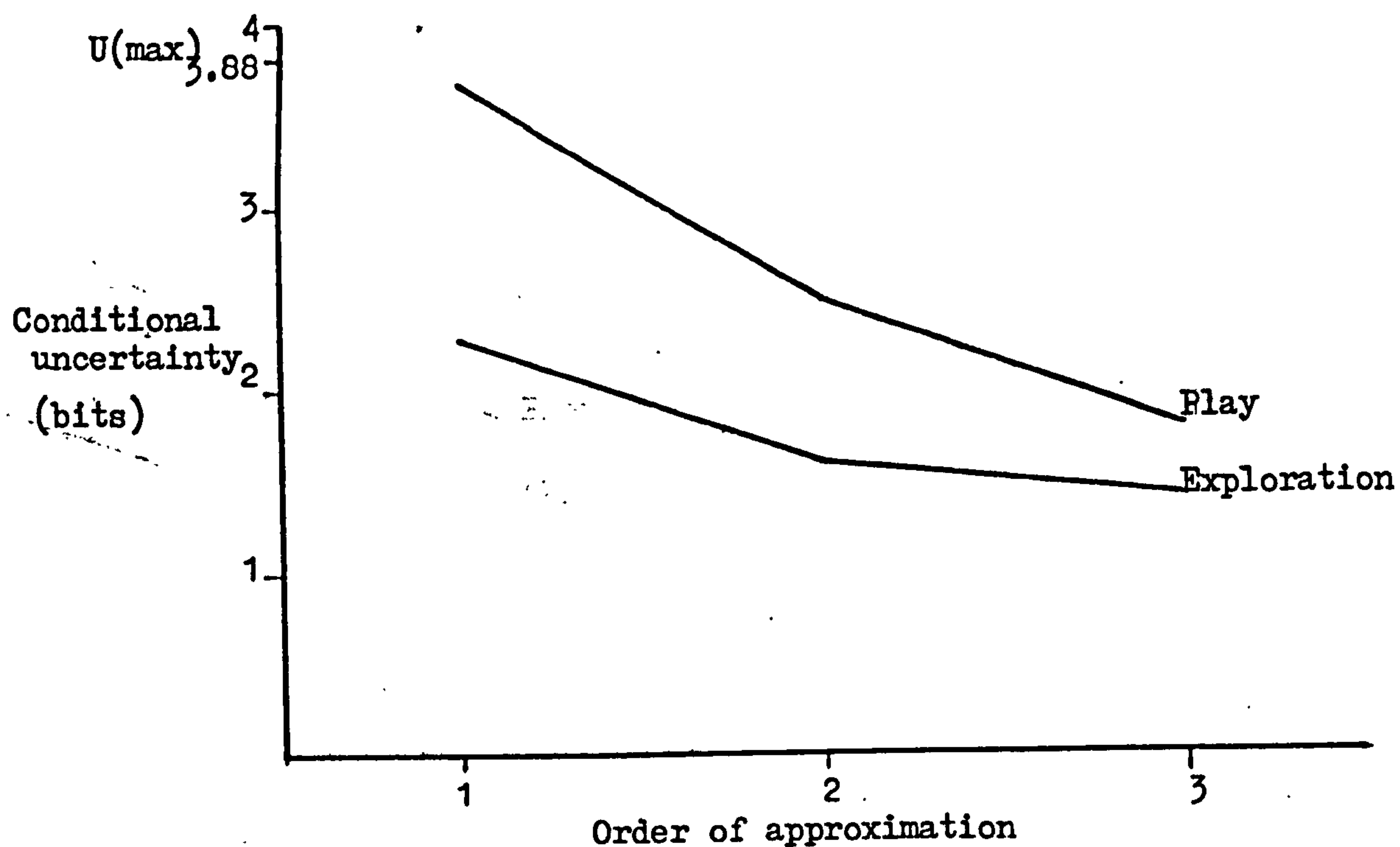
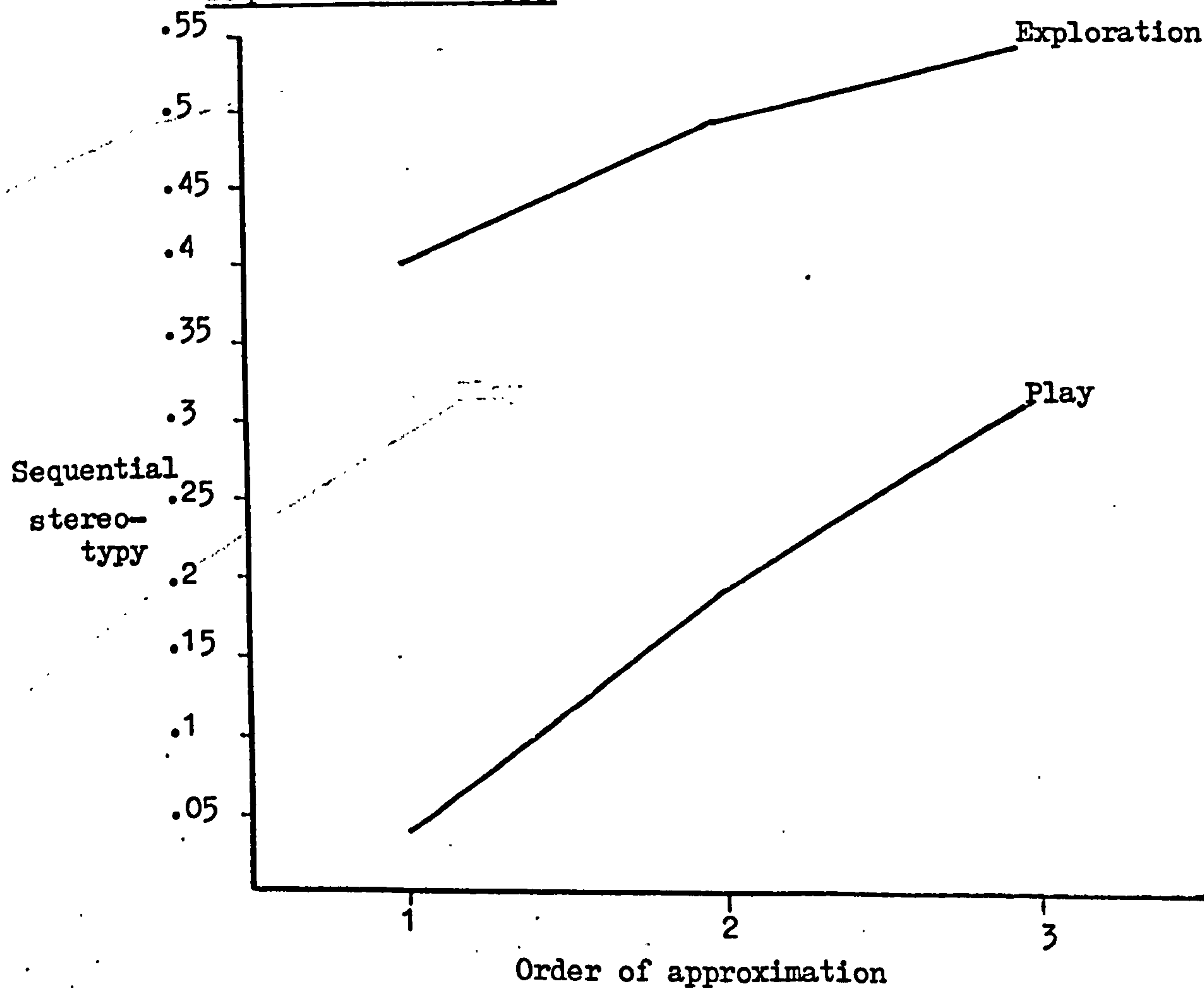


Figure 3.2 The relation between the order of approximation and the degree of sequential stereotypy



CHAPTER 4

HIERARCHICAL ORGANISATION OF EXPLORATION AND PLAY

Dawkins (1976) argued that "it makes both functional and logical sense" (p.15) that the organisation of behaviour should be hierarchical. That is, an organism's repertoire of behaviour should be divided into sub-sets which have characteristic sequential properties, and the behavioural decisions which are made within each sub-set should be largely independent of past behaviour outside that particular sub-set. Dawkins illustrated this argument by describing some of the ways in which the innately determined hierarchical organisation of behaviour can confer evolutionary advantage. The analysis of exploration and play which was described in Chapter 3 showed the different degrees of constraint in these behaviours; it could not, however, describe the organisation of behavioural events within those constraints. An hierarchical analysis of the way in which behavioural categories are organised within the sequential constraints enables the illustration and quantification of the inter-relationships between behavioural categories.

Study 2 - The hierarchical structure of exploration and play

This study examines the hierarchical organisation of behavioural elements during exploration and play in an attempt to extend the description of these behaviours given in Chapter 3.

METHOD

The data to be used are those from Study 1.

Analysis. The data from the exploration and play sessions were organised as transition probability matrices: thus, the elements of these two matrices were the probabilities of moving from one behavioural category to another during a ten-second period. The probability of moving from behaviour i to behaviour j is then described as p_{ij} . A function of d_{ij} was then defined such that $d_{ij}^2 = 2(1-p_{ij})$, and nearest- and furthest-neighbour cluster analyses (Gower, 1967) were carried out.

A nearest-neighbour analysis starts with n items and n clusters ($C_1 \dots n$) each of one item represented by each element in the transition matrix. For each pair of clusters C_i, C_j ($i \neq j$), the intercluster distance d_{ij} is calculated, and the clusters for which d_{ij} is a minimum are joined. These clusters are then deemed to form a new, single cluster, and the process of calculating inter-cluster distances is repeated. The distance between two clusters is determined by the distance between the two nearest points in each cluster.

The purpose of using this technique was twofold: first, to ascertain whether particular sub-sets of behaviour were consistently grouped for both exploration and play sequences (which might suggest potential modifications to the observational categories); and second, to consider the possibility that there may be functional groupings of particular sub-sets of behavioural categories which would subserve particular motivational needs.

A further neighbour analysis is essentially similar to

the above method, the difference being that the distance between clusters is defined as the distance between the two furthest points in each cluster. This technique was used in addition to the nearest-neighbour analysis to confirm the stability of the structures in the first analysis. As Gower (1967) points out, where a structure is stable nearest- and furthest-neighbour analyses will produce functionally similar results. Any discrepancies may be used to provide some insight into the nature of the overlap between clusters. Where the two techniques provide entirely different solutions this would indicate that the clusters were unstable as behavioural predictors.

RESULTS

The results of these analyses are represented in Figures 4.1 - 4.4 and Tables 4.1 - 4.4, and are to be considered in the specific ways:

- (a) a comparison of nearest- and furthest-neighbour clustering for exploration;
- (b) a comparison of nearest- and furthest-neighbour clustering for play; and
- (c) a comparison of the hierarchical structures of exploration and play.

The graphical representations of hierarchical structures shown in Figures 4.1 - 4.4 are scaled in such a way that they provide exact representations of the inter-cluster distances given in the Tables (computer graphics programmes were written by Dr. F. Grundy, University of Keele).

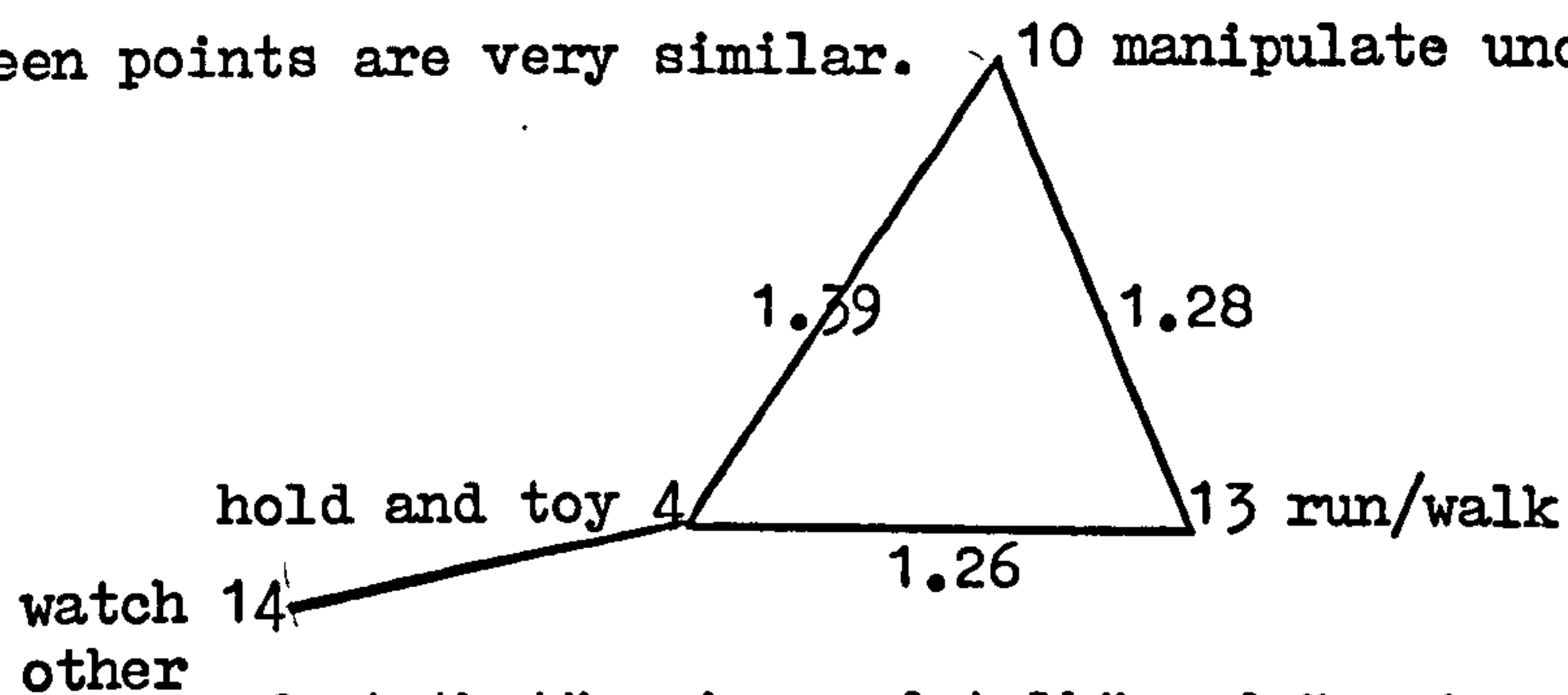
(a) Exploration

An examination of Figures 4.1 and 4.2 shows clearly that there are two stable clusters associated with exploration. The first is "lever, touch/finger, visual inspection" and the second "watch other, run/walk, manip. other". The other two behavioural categories associated with a child's first 'exploratory' session with a novel toy were "manip. and phys." and "hold and toy": the apparently unstable position of these two categories can be attributed to their very small contribution to the total observations during the session. "Manip. and phys." occurs, on average, once per subject, and "hold and toy" occurs only five times for all sixteen subjects (Table 3.1). Since the cluster "watch other, run/walk, manip. other" is so evidently associated with a child's temporary lack of interest in the novel object, the cluster "lever, touch/finger visual inspection" can be regarded as the paradigm behavioural cluster of exploratory behaviour. (This confirms the validity of the Markov analysis described in Chapter 3). The stability of the two clusters observed and the dichotomy within each suggest that a clear decision process is operating: either approach novelty or approach familiarity. The nature of the hierarchy precludes ready transition from one state to the other.

(b) Play

The hierarchies for play present an altogether less coherent picture: there seem to be three stable clusters, namely "lever, touch/finger", "watch other/hold and toy" and "manip. and gest., manip. and talk". The inconsistent ordering of the remaining eight categories is a reflection of the poor

discrimination which the distance measure ($d_{ij}^2 = 2(1 - p_{ij})$) effected. That is the distance between the behavioural categories within the clusters is such that the differential use of nearest- and furthest-neighbour analyses led to different linkages. Thus, in the furthest-neighbour analysis "run/walk" and manip. unconv." form a distinct cluster of two internal points at a distance of 1.28 units and this cluster lies at a distance of 1.39 units from the "watch other, hold and toy" cluster. In the nearest-neighbour analysis, however, run/walk" lies at a distance of 1.26 units from the cluster" watch other, hold and toy" and manip. unconv." lies at a further distance of 1.28 units. When this is illustrated diagrammatically it is easy to see how the apparent instability of the two methods arises if the distances between points are very similar.



The fact that "manip. and talk" and "manip. and gest." form a cluster in both analyses indicates a strong temporal relationship between these events, thus suggesting that their motivational antecedents may be similar. It is interesting to note that these elements would be strongly implicated in fantasy play which is typified at this age by a child giving a commentary on what he is doing and talking to imaginary co-players. The gestures are incorporated into a theme which, whilst it uses the novel toy, is not dominated by it. It has indeed been suggested that there may be specific motivational antecedents to

fantasy play (e.g. Singer, 1973) and it is therefore particularly interesting to note that this cluster is a stable one.

The "watch other, hold and toy" cluster is a good illustration of the child's willingness at this stage to hold the novel toy whilst actually looking at something else, thus demonstrating familiarity with the object. This familiarity is further reflected by the relative weakness of the association between "visual inspection" and the "lever, touch/finger" cluster.

(c) Exploration and Play

The Tables of Distances (Tables 4.1 - 4.4) give the impression that the distances between clusters are comparable for exploration and play and that the temporal relationships between events are therefore similar in the two sessions. It should be remembered, however, that the transition probabilities during exploration are relatively small since approximately 59% of transitions are within element ones compared to 44% during play, and the distances are correspondingly large. The high incidence of within element transitions itself acts as a constraint on behaviour. Even so, the greatest d_{ij} during exploration is 1.33 units as opposed to 1.35 during play (from nearest neighbour tables) indicating that the relationships between behavioural categories are at least somewhat more strongly defined during exploration. Furthermore, the stability of the structure of the behavioural elements during exploration stands out in contrast to the instability of structure in the play observations, thus lending credence to the original hypothesis that exploration

would necessarily be more structured than play.

When one considers the question of whether particular sub-sets of behavioural elements are consistently grouped the data are clear: "touch/finger" and "lever" have a consistent strong temporal association during both exploration and play, otherwise the clusters of behavioural elements for exploration and play are not consistent in their inter-relationships. During play, for example, the periods of visual inspection are brief (a mean of one 10 sec. observation per subject) and precede original manipulation of the novel toy; during exploration the periods of visual inspection are more frequent and longer (a mean of 6.6 observations per subject and a 0.4 probability of inspection for a further 10 second period) and precede specifically exploratory manipulation.

DISCUSSION

The hierarchical analyses demonstrate clearly that exploration is more highly structured than play and they illustrate the inter-relationships of the behavioural categories within this structure. Furthermore, they show that within exploration there are two clear sub-sets of behaviours - one associated with the novel object, the other clearly not associated with it. These findings can be interpreted as suggestive that there may be some particular evolutionary advantage associated with highly structured exploratory patterns, on the one hand, and more idiosyncratic play patterns on the other.

It is interesting to interpret these structural features of exploration and play in terms of the presumed arousal states with which they are associated (Berlyne, 1960; Hutt,

1970). The hierarchical structures illustrate clearly that during exploration a child's attention is highly focused on the salient features of a novel object. Easterbrook (1959) and, more recently, Kahneman (1973), have argued that the limitation of attention to only a few variables is related to physiological states of high arousal - an organism is responsive to a narrower variety of stimulation. Hutt (1966; 1970) has relied heavily on Berlyne's (1960) theoretical formulation that exploratory behaviour occurs in states of high arousal, and that play, conversely, occurs in states of low arousal. The above results have demonstrated a link between these two propositions; exploration (i.e. the high arousal state) is indeed characterised by attention to a narrower range of stimuli than play. The explanation of the results presented here, therefore, lends further credence to the value of CNS arousal as a conceptual framework within which exploration and play may be interpreted.

Since high arousal is also known to reduce task efficiency and to cause interference in cognitive mechanisms (Kahneman, 1973) it is clear that an innately structured behavioural pattern would be particularly valuable when the perception of novelty (i.e. "information conflict" to use Nunnally and Lemond's (1973) term) itself increases arousal. Thus, the demonstration of a stable hierarchical structure during exploration is a neat demonstration of the organisation of cognitive strategy. Furthermore, the idiosyncratic configuration of behavioural elements during play may itself have survival value but for quite

different reasons: i.e. play provides the opportunity to discover new uses for familiar properties of objects - as such, many authors (for example, Berlyne, 1968; Bruner, 1972) have considered play to be the precursor of 'creativity' in adults.

Also, the sequential determination of the behavioural events during exploration serves as an indicator of the purposive nature of this category of behaviour. Lashley (1950) argued that purposive behaviour, even in the higher primates, is characterised by sequential dependencies within a specific repertoire of behaviour; changes in experimental or motivational conditions may alter the frequency of some events but an essential "grammatical" order is nonetheless maintained. Highly determined sequences are regarded as highly purposive - thus exploratory behaviour is demonstrated as being more goal-oriented than play.

Finally, it must be said that one of the criticisms which is frequently made concerning research using direct observation of behavioural elements as data, is that the analysis and its outcome depend largely on the behavioural definitions. How fair is that criticism when levelled at the analyses described in Studies 1 and 2? If, for example, exploration were divided into a larger number of categories would these reveal a looser hierarchical structure? In fact, the evidence would not support this: even the division of "touch/finger" and "lever" seems to be an unnecessary one in the light of its consistency of temporal

clustering during both exploration and play. Since, during exploration, a child's interactions with the novel object always proceed from tentative to confident, it seems likely that a further breakdown of categories during this period would still result in stable clustering; and during play, it is unlikely that such further categories would ever be included in a predominant behaviour time-sampling analysis. A second alternative is obviously to reduce the number of behavioural categories (as in Chapter 3) and when this is done the results are essentially the same (i.e. exploration still reveals itself as more constrained). The great disadvantage of such a reduction is to reduce, for the reader, any insight into what the child is actually doing. Indeed, the hierarchy illustrations provide a very comprehensive description of what children actually are doing, and how the juxtaposition of these behavioural elements becomes characteristic of either exploration or play. The fact that, on the whole, the manipulation categories are unstable in their clusterings is really a validation of their separate definitions.

There are two major implications of this study. The first is that it demonstrates how cognitive strategy is affected in states of physiological high arousal, and thus extends the findings of Kahneman (1973) by showing that when cognitive mechanisms are impaired by arousal there may be compensatory innate behavioural mechanisms which serve to facilitate information processing and thereby

reduce arousal. Secondly, the lack of an adequate nomenclature for children's play has obscured distinctions that may be significant and has facilitated platitudes (e.g. "children learn through play"). The above analysis identifies "exploration" as distinct from "play" and points to the different functions they may serve: the constrained and obligatory category of exploration leads to the learning of new information, whereas the more haphazard and optional playful behaviour that follows is more akin to reconstitution, reorganisation or divergent utilization of that information.

TABLE 4.1

TABLE OF DISTANCES FOR EXPLORATION NEAREST NEIGHBOUR
HIERARCHICAL CLUSTERING

<u>Cycle No.</u>	<u>Distance</u>	<u>Cluster</u>
1	1.17	14-13
2	1.25	3-2
3	1.25	(3,2) - 1
4	1.3	(13,14) - 12
5	1.32	(1,2,3) - 8
6	1.33	(1,2,3,8) - (12,13,14)
7	1.34	4 - (1,2,3,8,12,13,14)

TABLE 4.2 TABLE OF DISTANCES FOR EXPLORATION FURTHEST
NEIGHBOUR HIERARCHICAL CLUSTERING

<u>Cycle No.</u>	<u>Distance</u>	<u>Cluster</u>
1	1.17	14.13
2	1.25	1-2
3	1.27	(2,1) - 3
4	1.32	(13,14) - 12
5	1.34	(12,13,14) - 4
6	1.41	(12,13,14,4) - 8
7	1.41	(12,13,14,4,8) - 1,2,3)

TABLE 4.3

TABLE OF DISTANCES FOR PLAY NEAREST NEIGHBOUR
HIERARCHICAL CLUSTERING

<u>Cycle No.</u>	<u>Distance</u>	<u>Cluster</u>
1	1	14-4
2	1.1	3-2
3	1.26	13 - (4,14)
4	1.28	9-7
5	1.28	10 - (13,4,14)
6	1.29	12 - (10,13,4,14)
7	1.3	1 - (9,7)
8	1.31	8 - (2,3)
9	1.31	(8,2,3) - (1,9,7)
10	1.32	11 - (12,10,13,4,14)
11	1.33	5 - (2,3,8,1,9,7)
12	1.33	(11,12,10,13,4 - 14) - (2,3,8,1,9,7,5)
13	1.36	6 - (1,2,3,4,5,7,8,9,10,11,12,13,14)

TABLE 4.4

TABLE OF DISTANCES FOR PLAY FURTHEST NEIGHBOUR
HIERARCHICAL CLUSTERING

<u>Cycle No.</u>	<u>Distance</u>	<u>Cluster</u>
1	1	14-4
2	1.1	2-3
3	1.28	9-7
4	1.28	13-10
5	1.34	12-11
6	1.36	6-5
7	1.38	(9,7) - (5,6)
8	1.39	8 - (9,7,5,6)
9	1.39	(13,10) - (14,4)
10	1.41	1 - (2,3)
11	1.41	(1,2,3) - (13,10,14,4)
12	1.41	(1,2,3,13,10,14,4) - (5,6,9,7,8)
13	1.4	(12,11) - (1,2,3,4,5,6,7,8,9,10,13,14)

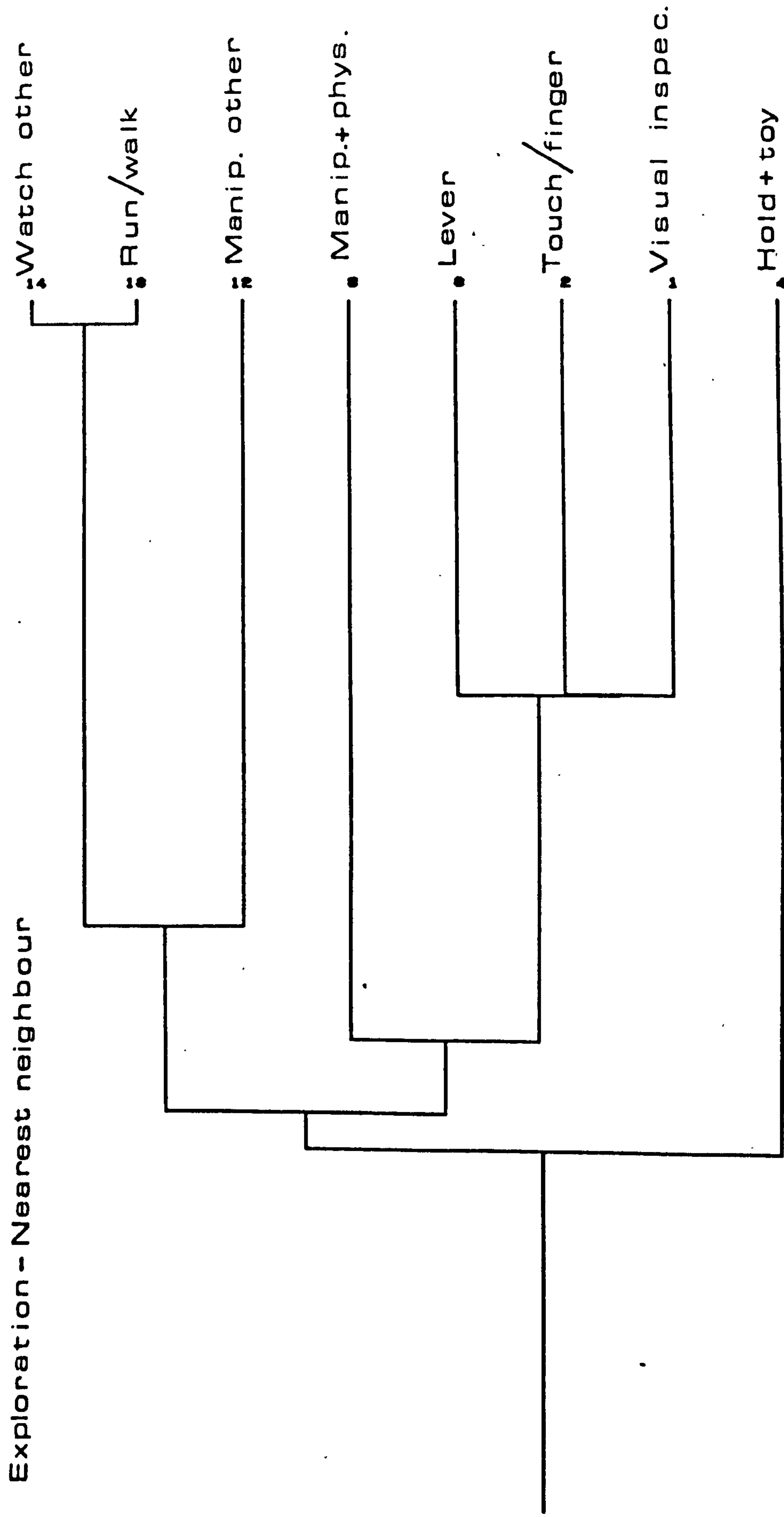


Figure 4.1 Exploration nearest neighbour hierarchy

Exploration - Furthest neighbour

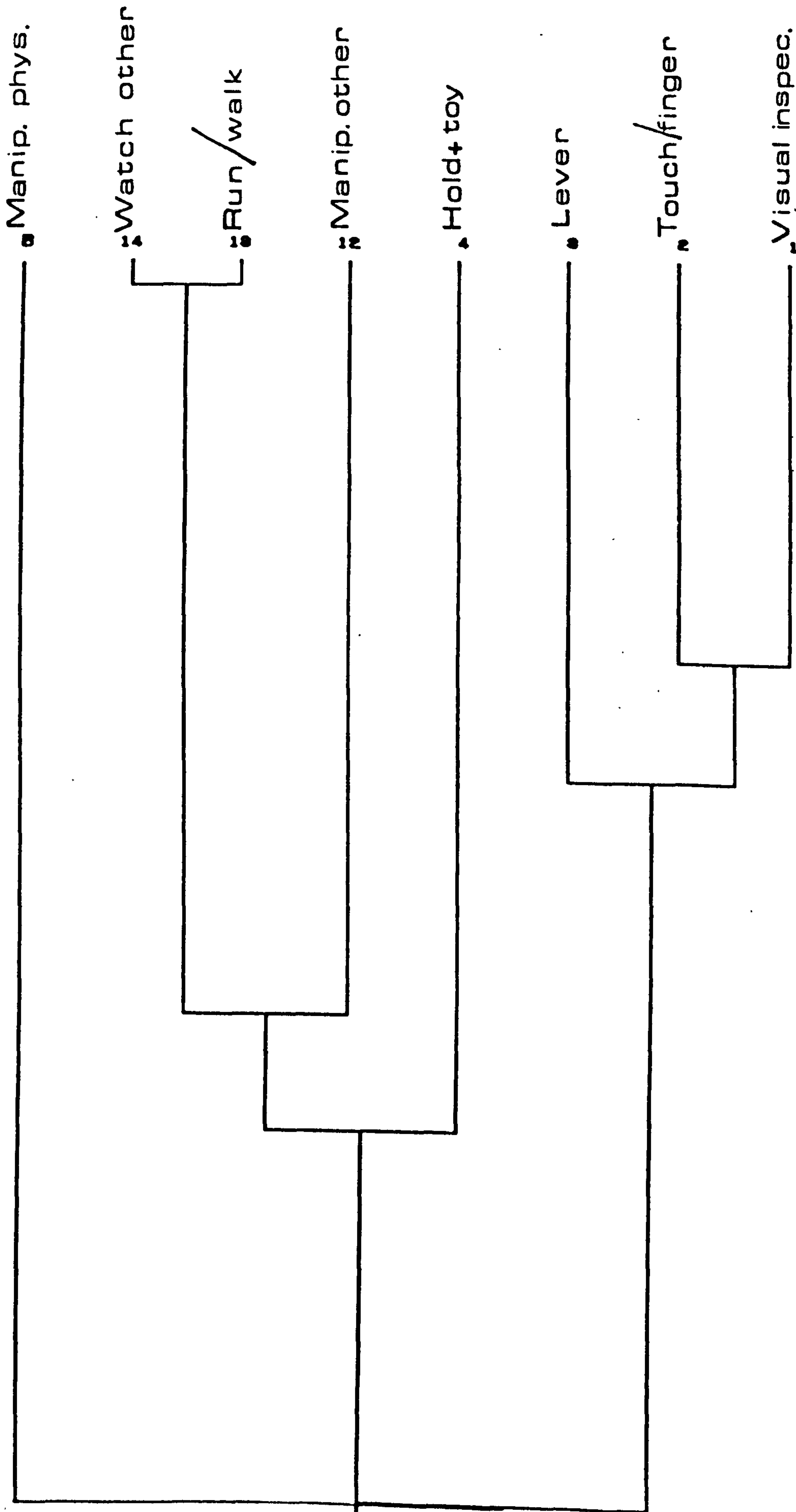


Figure 4.2 Exploration - furthest neighbour hierarchy

Hold + toy

Run / walk

Manip. unconv.

Manip. other

Push / pull

Manip. + talk

Manip. + gest.

Visual inspec.

Manip. + phys.

Lever

Touch / finger

Manip. + toy

Manip. fast

Figure 4.3 Play - nearest neighbour hierarchy

Play-Furthest neighbour

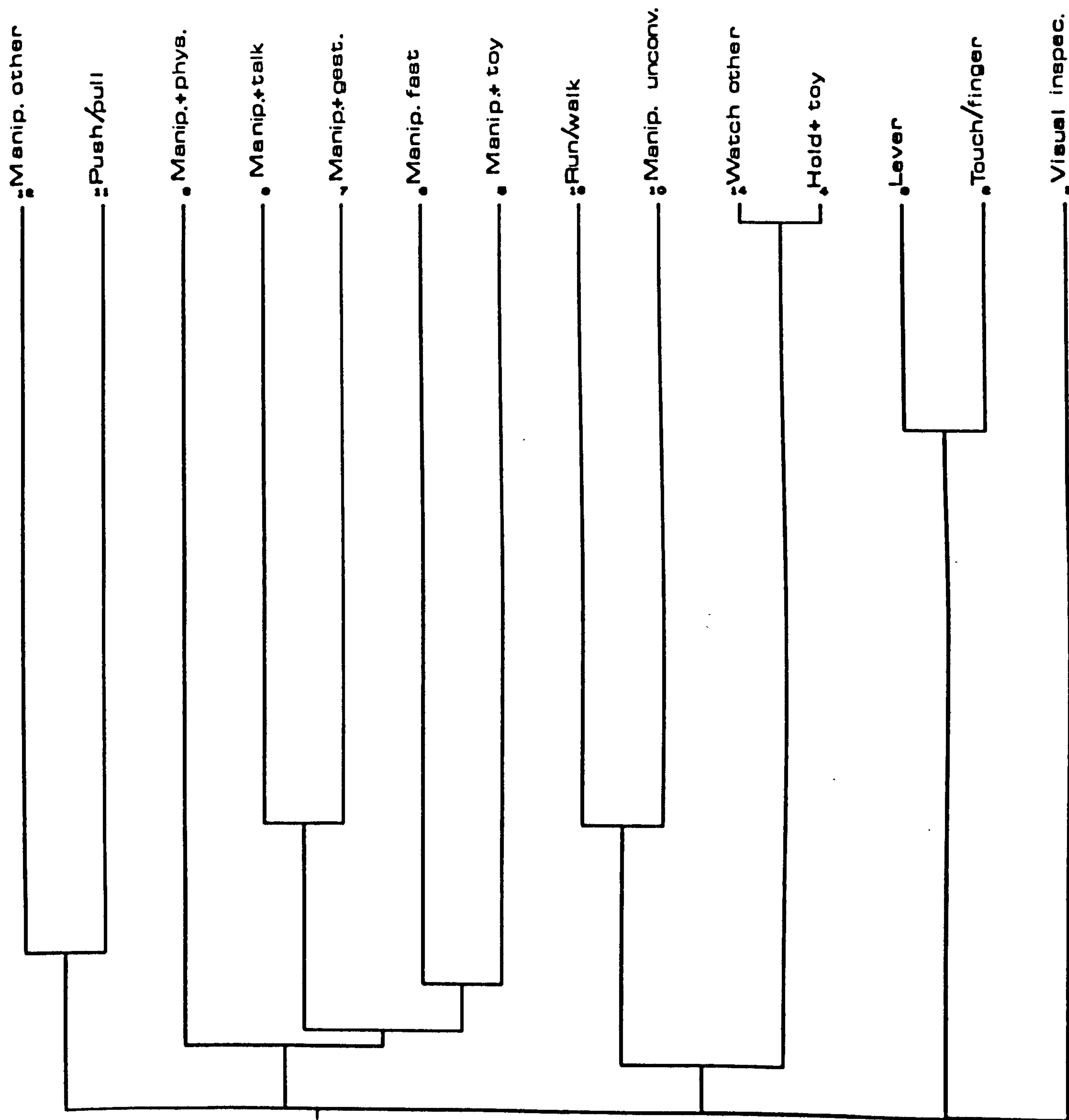


Figure 4.4 Play - furthest neighbour hierarchy

CHAPTER 5

PLAY: CONVERGENT AND DIVERGENT PROCESSES

In the experimental study described in Chapters 3 and 4 it was possible to distinguish between periods of activity which were purely exploratory or purely ludic in character. Children's exploratory interactions with a novel toy were characterised by intent facial expression, tentative handling, and visuo-motor co-ordination; in contrast during their ludic activity the toy was incorporated into games in which a child might manipulate the toy, but would not necessarily be concentrating on this action, and facial expressions became far more relaxed. It was argued that the introduction of a novel toy into a child's otherwise familiar playroom caused an increase in arousal, and that this arousal was optimally modulated by exploratory behaviour. The organization of exploratory behaviour was consistent amongst the children observed, and it was suggested that exploratory behaviour enabled a child to learn about the properties of a novel stimulus. Hutt (1966) observed that if a child failed to discover one of the properties of the novel toy during exploration, s/he was unlikely to discover it during subsequent play.

In this chapter, two studies are reported which attempt to evaluate the way in which children obtain information about materials during "free play". In the classroom, it is often virtually impossible to tell whether a child is 'exploring' or 'playing' with objects and there has been a pervasive philosophy within the pre-school movement that by merely exposing children to a wide variety of materials they will somehow magically absorb the salient properties of those materials

(Stallibrass, 1974); although in recent years there have been some cogent arguments against this view (Hutt, 1979(a); Hutt, Hutt, Tyler and Foy, 1981).

The Reports by Sylva, Bruner and Genova (1974) and Smith and Dutton (1979), both indicate that children who have some pre-exposure time to materials later to be used in a problem-solving task, are at an advantage to children who have simply been shown the properties of the materials. In the Sylva et al experiment, children sat in a chair with 3 sticks and a G-clamp at their side, and were asked to reach a piece of chalk in a box that was out of reach. To solve the task, children had to clamp the 2 longer sticks together and use the joined stick to reach the chalk. Hints were given if the children had difficulty. There were two experimental groups (E1 and E2) and a control group C. The children in E1 were shown how to use the clamp and then allowed some "free play" time with the materials; the children in E2 were given a demonstration of the appropriate construction to solve the problem; and the children in C were shown only how to use the clamp. There was no difference in the number of hints children needed in the two experimental groups; however, children in the control group did require more hints. In a second experiment, using the same problem-task, Sylva et al yoked the children in the play condition (E1) of the first experiment to two new groups: a demonstration group (D) and a training group (T). Each child in the D and T groups either saw an adult demonstrate the configurations of sticks and clamps which had been made by a child in E1, or they were trained to build those configurations. Thus, for each

child in the E1 group, there was a matched child in the D group who had had a play demonstration, and a matched child in the T group who had been trained to make the same configurations that the E1 child had spontaneously made during play. Both the T and D groups required more hints than the E1 group to solve the task and Sylva et al argue that the play experience was superior to the demonstration and training experience as a means of learning about the materials. They draw an analogy between their experiment, and those of Jackson (1942) and Birch (1945) who each found that chimps who were given play experience with a stick were later able to use the stick in a skilled way to solve a task requiring the acquisition of a distant lure; and Schiller (1957) in a similar experiment also found that play with several interlocking sticks had a significant impact on chimps' later use of the sticks to acquire a lure.

There are however, some problems with the experiments of Sylva et al.. In the first experiment the children were not exposed to the materials for an equal amount of time. The play group (E1) was allowed to handle the materials for ten minutes, while the demonstration group (E2) and the control group received exposure times of two minutes and one minute respectively. In view of the ultimately similar performance of groups E1 and E2 it might be concluded that demonstrating to a child how to do a task is the most efficient way of teaching him/her the properties of the materials involved! A second difficulty, applicable to both experiments, is that task performance was evaluated as a function of the number of hints given, with no adjustment for the level of the hint.

Since the hints were scaled to reveal increasing amounts of information two hints at the beginning of the task were not really comparable to two hints at the end of the task: Sylva et al. did not attempt to make any discrimination on this basis. A third difficulty is really a semantic quibble: were the children in E1 playing in the ludic sense, or were they exploring? In the absence of any behavioural observations there can be no definitive answer, but a replication of this experiment with some simple behavioural observations would examine the question of whether children do indeed "learn through play" or whether they "learn through exploration".

Smith and Dutton (1979) tackled some of the design problems of the Sylva et al. experiment: first, the training experience was of the same duration as the play opportunity, and second, the experimental and control groups were all given an initial familiarization time with the materials "to allow some brief exploration" (p.831). They also introduced a further problem for the children which required them to join 3 sticks (and was therefore considered harder; Smith and Dutton suggest that it requires innovative problem-solving). Their results showed that children in both the play and training conditions performed significantly better than children in the control condition who had merely had the 3-minute pre-task familiarization period. In the second (more difficult) task children who had been in the play condition were more likely to solve the problem spontaneously than children in the training condition.

Smith and Dutton argued that the relatively greater efficacy

of play opportunity over direct training for more innovative problem-solving is a consequence of "flexible, combinational activity....learning an innovative behaviour sequence which combines behaviour elements, or subroutines, in ways which are new is unlikely to be learned directly by non-playful practice." (p.835). However, they do not document whether any children in the play condition did actually 'discover' the appropriate elements or subroutines to solve the problem. There therefore remains some scope for examining the way in which children play with materials during pre-exposure, and relating this to subsequent performance on a problem-solving task.

Study 3 - Play and convergent problem-solving

The major aim of this study was to clarify and extend the findings of Sylva et al (1974) and Smith and Dutton (1979). However, some modifications were made to the experimental procedure and data collection which permitted a slightly different analysis. In order to examine the significance of the way in which children played with the materials during the pre-task period, two distinctive sets of materials were designed, both of which were equally appropriate to the eventual task. Set A comprised 3 brightly coloured sticks (each 18" in length), and 3 strips (keys) of copper tubing (2mm diameter, $2\frac{1}{2}$ " long with rounded end); each stick had a small slot at one end and a rounded section of copper tubing (insert) at the other. Two sticks could therefore be joined by placing the insert from one stick into the slot of another, and sliding a key through the insert to secure the join. Set B comprised a similar

set of materials except that the "sticks" were designed to look like dolls: there was a policeman, a red indian, and a woman holding a baby; and the "keys" were designed to look like a small truncheon, a tomahawk, and a baby's rattle. It was hypothesised that Set B would elicit more ludic behaviour from the children than set A because Set B could be more readily incorporated into representational play. Set A was expected to elicit more exploratory behaviour because of the more ostensibly unusual features of the materials. (Figures 5.1 and 5.2 illustrate the materials).

METHOD

Subjects were 40 children aged 4-5 years drawn from pre-school playgroups with a predominantly white, middle-class (professional parents) intake.

Procedure: The experiment took place in a small room within the pre-school. Children came into the room with E and were shown either Set A or Set B of the task materials. E explained that these were some toys she had brought with her, and that she wanted to see what sort of things children could do with them. The children were invited to play with the toys for a bit, and were told that after a few minutes E would want to know whether they thought the toys would be useful to have in the playgroup. During a five-minute pre-task period the children were observed, and data were collected on a checklist which recorded the occurrence of behaviour which would be used in the subsequent problem-solving task: these behaviours included 'inspection of slots or inserts', 'putting a key through the insert', 'appropriate matching of slot + insert' and 'inappropriate matching of slot + insert' (for example, placing two sticks on top of one another rather than joining them lengthwise); any

occurrence of clearly ludic behaviour was also noted (for example, one child built a wigwam and then a road with the coloured sticks; another child enacted a complex sequence of events including the mutilation of the policeman by the indian). Children who were inactive or expressed boredom were positively encouraged by E to 'try and think of an interesting game you could play', until the full five minute period was completed.

Task: After each child spent five minutes familiarizing himself with the materials, E explained the task: a strip of white tape had been placed down the centre of the room before the experiment began, and the child was told that he could not now cross this white line. A jelly baby was placed in a paper cup, which had a large handle attached, on the opposite side of the line to the child. The child's problem was to obtain the jelly baby without crossing the white line. He was told he could use the toys to help him if he wished.

Hints: A series of hints, arranged so that each succeeding hint revealed more information about how to solve the task, was developed. These were offered to the children if they were inactive for 30 seconds or indicated that they wanted help. The particular hint that was given depended on the child's performance in such a way that a given hint was always one level above the strategy already attempted. For example, if the child attempted to reach the object with a stick, and then gave up, he was then given the hint which suggested using a longer stick.

Level 1. (Child flummoxed at outset)

"You would be able to reach it if you had very long arms, wouldn't

Figure 5.1

Experimental materials for
Study 3. (Set A).



Figure 5.2

Experimental materials
for Study 3 (Set B)



you? Could you use the toys to make your arms long?".

Level 2. (Child tries to reach using one stick)

"Could you make a longer stick that would help you reach"?

Level 3. (Child unable to make longer stick)

"Could you join two of the toys/sticks together somehow?"

Level 4. (Child makes no progress joining sticks)

"Look, you can join them like this". (Slot and insert joined, but not keyed together).

Level 5.(Child has joined sticks, but can't make them stay together).

"Could you use one of those little toys to help join them?"

Level 6. (Child unable to use keys).

"Look, if you put this in here, the sticks/toys will stay together when you pick them up".

Scoring: Scores on the task were developed so that a child who only had a low level hint scored lower than a child who had only a high level hint. (See Table 5.1). It was assumed that for the first 5 hints the successive increments of information revealed were equal, and children were given one to five points respectively for each of the first 5 hints which were needed. Since the last hint revealed the entire solution a weighting of 9 was given if it was needed (so that solving the task with the 4th and 5th hints was equivalent to solving the task with the final hint).

Table 5.1 Scoring on problem solving task

		<u>Points given for needing hint</u>
<u>Level of</u> hint	1	1
	2	2
	3	3
	4	4
	5	5
	6	<u>9</u>
Total		24

An exploration score 0-5 was devised based on the observational measures in the pre-task period. A zero score indicated that the child had paid no attention at all to the slots, inserts or keys, whereas a score of 5 would have indicated that the sticks had been joined lengthwise using the keys (See Table 5.2).

Table 5.2 Exploration scores

0	No attention to slots, keys, or inserts.
1	Visual inspection and manipulation.
2	Key through slot
3	Key through insert
4	Sticks joined without key
5	Full construction appropriate to task

RESULTS

As predicted, the children who spent the pre-task period with Set A were more likely to spend time exploring the materials than children who played with Set B; children with Set B were more likely to engage in at least some clearly ludic behaviour. The median exploration score in Group A was 3.2 and in Group B was 2.1 (Mann-Whitney $U = 135.5$, $p < .05$ (1-tailed), $N_1 = N_2 = 20$). Only 3 children in Group A displayed any ludic behaviour, compared to 11 children in Group B ($\chi^2 = 7.03$, 1df, $p < .01$). No children from either group made a full construction appropriate to the task. The higher exploration scores of Group A showed that children in this group were engaging in more task-related activity than Group B, although their behaviour was epistemic rather than ludic in the

sense of Hutt's (1979b) taxonomy.

Table 5.3 shows the mean task scores (a function of the number of hints needed) and the mean times taken to complete the task by the two groups. No child was able to solve the problem without being shown how to join the sticks using the keys, so the lowest score was 9 (one child from each group). There was no significant difference between the two groups on the time taken to solve the problem ($t = 0.31$, $df = 38$, n.s.) but Group A had a significantly lower mean task score showing that they needed fewer hints ($t = 1.899$, $df = 38$, p (2-tailed) $\approx .062$).

Table 5.3 Task scores and times to completion		
	Mean task score	Time taken (secs.)
Group A	16.1 \pm 3.2	334.5 \pm 77.1
Group B	18.049 \pm 3.3	327.7 \pm 57.6

DISCUSSION

One surprising aspect of this study was the degree of application which children showed in trying to solve the problem; it is in marked contrast to the Smith and Dutton (1979) study where more than one-third of their subjects in a "training" and three quarters of their subjects in the control condition (which was 3 minutes familiarization time with the materials) were unwilling to concentrate on the task presented to them. In effect, the present study distinguished the

effects of 'epistemic' and 'ludic' play behaviour, and they were equally potent in maintaining the children's interest in the problem; but it is not clear exactly why the children in this study did not lose interest in the same way as the children in the Smith and Dutton experiment. One possible reason is the different nature of the subject sample. Another possibility is the lack of constraint on the children's behaviour in the present study: Smith and Dutton required their subjects to sit formally at a table; the subjects in the present study were permitted a good deal more freedom of activity during the pre-task period, they may therefore have felt less constrained by the adult presence. As Loizos (1967) and Bruner (1972) have both pointed out, a child will not play in surroundings which create a feeling of insecurity; the children in the Smith & Dutton study may well have found the experimental conditions so aversive that they engaged in "displacement activities" which distracted them from the task ahead.

The present study does exemplify that when children respond to objects as having a familiar use (the dolls in Set B), they do not examine the less familiar features which may be present. Their behaviour is 'ludic', in that it is relaxed and incorporates the objects into a variety of activities; children who are confronted with materials which are relatively unfamiliar, and have no obvious use, 'explore' the properties of those materials. It is exploration which gives children an ultimate advantage in using the materials in a problem-solving situation.

Study 4 Play and Creativity

In Study 3 the children were involved in trying to solve a

problem to which there was a 'right' answer, and finding the right answer depended on an appropriate knowledge of the materials. The finding that exploration facilitates this kind of convergent thinking cannot necessarily be generalised to divergent thinking processes. Divergent thinking is generally regarded as more creative (Hudson, 1968, 1972), and numerous writers have suggested a relationship between play and creativity (Dansky and Silverman, 1973; Hutt and Bhavnani, 1972; Lieberman, 1977; Sutton-Smith, 1966; Wallach and Kogan, 1965). Since it is during ludic behaviour that children typically use materials in different ways ("what can I do with this object?" Hutt, 1970) it may be that ludic behaviour facilitates divergent thinking, whereas exploratory behaviour facilitates convergent thinking. Sutton-Smith (1967) is explicit in his assertion that "play increases the child's repertoire of responses and cognition so that if he is asked a 'creativity' question involving similar objects and associations, he is more likely to be able to make a unique (that is, creative) response." (p.366), thereby suggesting a direct relationship between ludic behaviour and divergent thinking. Hutt and Bhavnani (1972) distinguished 'inventive explorers' (IE) from more orthodox 'explorers' (E) and 'non explorers' (NE) (IE children were those who, after investigating a novel toy, used it in many imaginative ways - that is, they were the children who found original uses for the toy during their ludic activity) and reported that when these children were tested, using standard creativity tests, three years later, the IE children scored significantly more highly than children in the E and NE groups.

Dansky and Silverman (1973, 1975) examined associative fluency in the 4-6 year olds. They found that children who spent a period of free play with a set of everyday objects (paper clips, corks etc.) were able to suggest more possible uses of these objects than children who had watched and imitated the actions of an experimenter with these objects.

With the exception of the Hutt and Bhavnani (1972) study, experimental work on the relationship between play and divergent thinking has not made any analysis of the type of play in which a child engages prior to testing. The time lag between observation and testing in the Hutt and Bhavnani study precludes the confirmation of an immediate effect of play on creativity, so there is clear scope for an experiment which examines these effects. Study 4 therefore examines the hypothesis that ludic activity prior to testing facilitates creative responses.

METHOD

Subjects were 30 children from a primary school reception class with predominantly lower-middle class intake. The age range was 4 years 9 months - 5 years 9 months.

Apparatus The children sat individually at a small table on which were: paper towels, wet cups, wooden cotton reels, pipe cleaners, paper clips, blank cards, empty matchboxes, and spent matches. A colouring book and crayons was provided for children in the control condition.

Procedure: Ten subjects were randomly allocated to each of three

conditions: a 'play' condition (P) in which children could do as they wished, an imitation condition (I) in which the children copied the experimenter, and a control condition (C) in which children spent six minutes in the experimental room colouring pictures.

In the Play condition the child sat at a small table; the experimenter introduced him to the experiment by asking him to identify the objects and deliberately tried to develop a relaxed atmosphere. The experimenter then said "Now I'm going to sit over here, because I have some work to do. You can play with these things for a few minutes. Do whatever you like with them." The child's behaviour was observed for six minutes. The experimenter then went over to the child, picked up the paper towel, and said "There are lots of things you can do with a paper towel, aren't there? I want you to tell me all the things you can think of. What things could you make with it? What things could you use it for?" When the child had finished responding to this request, he was shown one of the pattern-meaning cards from the Wallach and Kogan (1965) test battery, and the experimenter said "Now I want you to look at this pattern and tell me all the things you think it could be. You can turn it round and look at it from any side. Use your imagination and think very hard, there are lots of things it could be."

In the Imitation condition, the experimenter introduced the child to the objects in the P condition but then said "Now I want you to watch what I do and then you do the same." The experimenter then spent six minutes wiping the cups with the towels, filling and emptying the matchboxes, putting the pipecleaners through the cotton reels, and clipping and unclipping the cards using the paperclips.

The child was then asked to think of as many uses as possible for the paper towel and to do the pattern-meaning task (as in P).

In the Control condition the child was in the room with the experimenter but was given crayons and a colouring book rather than the other materials. The final testing procedure was as in conditions P and I.

Observations: Since it has been argued that children's creative responses are a function of the flexibility of action inherent in play (Sutton-Smith, 1967, 1971) children in the P condition were observed to find (a) the amount of time the paper towel was actively being used, and (b) in what combinations it was used with other materials.

Test measures: The alternative uses task is a well established component in divergent-thinking tests, and was used by Dansky and Silverman (1973). Since they found that the paper towel elicited the most responses from their subjects, it was used as a directly comparable measure with that experiment. Responses to this test were expected to be partly a function of the children's play with the paper towel during the pre-test period. Responses were scored either as standard (when they referred to a use for which the object had been primarily designed) or non-standard (all other acceptable responses), in accordance with Dansky and Silverman (1975).

The pattern-meaning test was used as a measure which was independent of the items the children had access to during the pre-test. It was intended to provide a measure of whether the play condition created a better 'set' for creative thinking than the imitation and control conditions, since both Wallach and Kogan (1965) and Lieberman (1977) argue that the mode of thinking in play

is comparable to that in creativity.

RESULTS

A 'play richness' score' was devised for children in the P condition by giving a score of one for each time they combined the paper towel with another object during play. Scores ranged from 2 to 5 (mode = 2). These scores were positively correlated with the total number of uses ultimately given for the towel in the alternate uses test (Spearman rank correlation = 0.59, $p < .05$). The total time spent playing with the towel was also correlated to the total number of uses suggested (Pearson $r = 0.62$, $p(2\text{-tailed}) = .056$). The low play richness scores reflect the children's lassitude in playing with the experimental materials; in general, their play was little more than drying cups and putting the matches in boxes. The child with the highest score dried the cups, then wrapped them up and put pipe-cleaners round to hold the paper on; he then put the matchboxes on top and covered them with another towel. However, there is no doubt that the observed spontaneous manipulative play tended to be ludic rather than epistemic, although it did lack the happy characteristics normally associated with ludic behaviour.

Table 5.4 shows the means and standard deviations of the scores in each of the creativity tests. One-way ANOVA's revealed no significant differences between the groups in their scores on standard uses, but children in the play condition scored significantly better than the children in the other conditions on both non-standard uses and pattern-meanings. ANOVA tables, together with Newman-Keul's post-hoc comparisons are shown in Tables 5.5 - 5.7.

Table 5.4 Creativity test scores			
Exptl. group \ Test	Standard uses	Non-standard uses	Pattern-meanings
P	4.3 ± 1.9	6.4 ± 2.4	6.8 ± 1.6
I	3.8 ± 1.7	4.3 ± 1.6	4.4 ± 2.5
C	4.1 ± 2.4	3.2 ± 1.5	2.7 ± 2.8
Difference between groups	n.s.	p < .01	p < .01

Table 5.5 ANOVA on standard uses scores				
Source	SOS	df	MS	F
Experimental condition	1.267	2	.63	.157 n.s.
Error	108.6	27	4.02	
Total	109.87	29	3.789	

Table 5.6 ANOVA on non-standard uses scores				
Source	SOS	df	MS	F
Experimental condition	52.87	2	26.43	7.58 p < .01
Error	94.1	27	3.49	
Total	146.97	29	5.07	
Newman-Keul's post-hoc comparison: q (P-I) = 3.5, p < .05 q (I-C) = 1.7, n.s.				

Table 5.7 ANOVA on pattern-meaning scores				
Source	SOS	df	MS	F
Experimental condition	84.87	2	42.4	7.5 p < .01
Error	152.1	27	5.6	
Total	236.97	29	8.17	
Newman-Keul's post-hoc comparison: q (P-I) = 3.2, p < .05 q (I-C) = 2.3, n.s.				

DISCUSSION

The results of this experiment provide strong support for the view that spontaneous manipulative play does facilitate the expression of creative ideas: both with materials that have been incorporated in play, and with independent test material. The concurrent observations during the pre-test periods identified occasions when children were using combinations of the materials, and the finding of a significant relationship between play richness and subsequent creativity scores is confirmation of the view that the flexible, combinatorial sequences of behaviour during play are pre-cursors of creativity. The finding that there was no difference between the experimental conditions in the number of standard uses they were able to suggest for the paper towel is actually inconsistent with the Dansky and Silverman (1975) results; however, it does emphasise that the pre-test play facilitates novel ideas rather than orthodox ones.

The classification of the spontaneous play as ludic rather than epistemic was not as clear in this experiment as in Study 4. Nevertheless, the children clearly were familiar with the materials, despite the fact that some of them were a little baffled when confronted with such a motley collection of objects. Clearly any experimental situation is not entirely conducive to relaxed, ludic behaviour, but the children in the Play condition approached this state more closely than in the Imitation or Control conditions. The behaviour of the children in the I group was certainly more epistemic in that it required the child to attend to the experimenter, and to reproduce her actions; it therefore did not permit the child to

engage in behaviour of the type "what can I do with this object?"

The better performance of the P group children relative to the I and C groups on the pattern-meanings test does lend support to the views of Bruner (1972), Lieberman (1977) and Wallach and Kogan (1965) that the state of mind associated with playfulness is related to divergent thinking. If the arousal dimension is an appropriate one, then it may be suggested that low arousal is associated both with ludic activity and divergent thinking; indeed, there is some evidence to that effect in an experiment which reports relatively low levels of EEG arousal associated with creativity (Martindale and Hasenfus, 1978).

Both Study 3 and 4 have been primarily concerned with manipulative play, and it is straightforward to classify this type of play on a ludic-epistemic dimension of the type proposed by Hutt (1979b). However, much of the play that children engage in is symbolic - that is, the child enacts adult (or other) roles, and uses materials to represent a variety of objects (rather than being interested in the materials for their own sake). Whereas manipulative play is seen in other primates, symbolic play is uniquely human. The possible relationship of symbolic play to arousal is not as clear as in the case of manipulative play; Hutt classified it towards the ludic end of the spectrum, but her reasons for doing this are not clear. The following chapters therefore offer some consideration of motivational and functional aspects of symbolic play, and attempt to classify it within the existing conceptual framework.

CHAPTER 6

SYMBOLIC PLAY - A SPECIAL CASE

Because symbolic play is uniquely human, it has merited special attention by play theorists. This chapter discusses the various functions which have been attributed to symbolic play, and examines the empirical evidence in their support. An idea which has been very influential in play theory (Groos, 1898; Piaget, 1951; Smilansky, 1968; Singer, 1973) is that symbolic play is a crucial pre-cursor of adult conceptual ability; such play is thought to provide an opportunity for the manipulation of symbolic representation which is an essential pre-requisite of formal operational thinking. Thus, in the same way that manipulative play with objects enables children first to learn the properties of those objects (exploration) and subsequently to consolidate them (ludic activity), symbolic play could be thought of as the absorption and consolidation of ideas. Imitation (representational play) during which a child repeats behaviour he has seen enacted by adults (for example, washing-up, or driving) and focuses on the salient aspects of those events, could be regarded as analogous to exploration; whereas fantasy play, during which a child integrates these events into a creative theme (for example, the acting out of doctor and nurse roles, or the pretence of an expedition to an imaginary land) would be analogous to ludic behaviour. This conceptualization is similar to the Piagetian view which regards imitation as the "continuation of accommodation" whereas play is regarded as assimilation.

The identification of exploratory and ludic activity is not always straight forward; there are transition states on an epistemic-

ludic dimension. Similarly, the dichotomy of fantasy and representational play is not an absolute one; it is equally rarely made. However, many authors (for example, Fein 1975; Feitelson 1975) have observed developmental changes in children's symbolic play which indicate that younger children's play makes more use of 'literal' representations of objects (for example, small plastic cups, and toy guns) than that of older children. Children apparently acquire the ability to use non-literal representations of objects through experience of using more obvious representations.

In the absence of a theoretical framework of this type, most authors have not made a distinction between various categories of symbolic play. The terms 'symbolic play', 'fantasy play', 'socio-dramatic play', 'representational play', and 'make-believe play' are used synonymously, and this type of play is widely regarded as having some coherent role in development. In the following review, therefore, the terms of the original authors have been maintained; where feasible, their results have been re-interpreted, but the basic intention of the review is to examine the nature of the claims which have been made concerning the importance of symbolic play.

6.1 The experimental study of symbolic play: intervention studies

According to Piaget (1951), symbolic play can be seen as a stage in a developmental sequence of play behaviour which parallels the development of cognitive processes. During symbolic play, the child begins to explore his relationship with the adult world through role play and experimentation with objects. The ability to engage in symbolic play is, he argues, unique to man, and reflects the child's developing skills of intellectual abstraction and symbolic representation. He illustrates his argument with the anecdotal

description of a young child rocking a rag and gently telling it to sleep. In this instance we see evidence of symbolic representation, of role play, and of the ability to represent the essence of the "going to sleep" process. Fein's description (Fein, 1975) shows how children develop the ability to select relevant attributes in apparently irrelevant materials - thus, while the initial stages of fantasy play use literally representational objects, the more sophisticated fantasy play of later childhood is not dependent on 'literal' props.

Working within the Piagetian framework, Smilansky (1968) was the first to implement an intervention programme in children's sociodramatic play, and her book offers a detailed description of her work with immigrant children in Israel. She regards the ability to sustain thematic play as an essential constituent of cognitive development (referring extensively to Piaget), and she also takes the view that, within sociodramatic play, the child develops creative skills and learns social co-operation. She says, "socio-dramatic play seems to be one of the means that most naturally meets the needs of the culturally disadvantaged child. By its very nature it demands from the child that he utilize his potential abilities and knowledge, combine his scattered experiences in a flexible way, in an almost lifelike situation." (page 3). A group of experimental workers therefore set out to "teach the child full utilisation of his scattered experiences, knowledge and vocabulary in an imaginative combination, to develop in him the ability of positive social interaction, and to enrich his language and broaden his concepts through the interaction with co-players, peers and adults." (page 4). Smilansky points to the fact that the culturally disadvantaged home often does not provide children with the require-

ments necessary to further socio-dramatic play and argues that therefore "some kind of adult intervention in the kindergarten is imperative in order to develop the socio-dramatic play of disadvantaged children (immigrants of low socio-cultural background) and enable them to benefit from this experience, which we regard as most important for success in school." (page 86).

Three treatment levels were used in her study: (A) Children received guided visits to and discussions about places of interest - the hypothesis being that if the children are provided with meaningful impressions and experiences within their comprehension, they will begin to engage in socio-dramatic play without adult intervention in the play act itself. (B) Children were taught "how to play", on the assumption that if adults teach them "how to play", they will begin to display their own experiences in the form of socio-dramatic play. (C) was a combination of (A) and (B), based on the assumption that the most disadvantaged children lack both understanding of behaviour and phenomena and the experience in play technique. All three intervention strategies were specifically designed to develop the techniques of socio-dramatic play rather than to enhance any particular aspect of the children's development. Treatment lasted nine weeks and included a total of 67 hours of socio-dramatic play in addition to time spent on visits.

Children in groups (B) and (C) showed a significant increase in levels of socio-dramatic play following the intervention, although children in group (A) showed no increase; the children in group (C) showed a greater increase than those in group (B). There was no relationship between attainment in socio-dramatic play and I.Q. (i.e. at the end of the intervention period); nor were there any

sex differences in levels of play attainment. Children aged 5-6 years showed relatively greater levels of attainment in socio-dramatic play than children aged 4-5. Smilansky also tentatively suggests that the intervention may have had a significant effect on verbalisation during play in that both the range of the vocabulary and the mean lengths of utterances during play improved for groups (B) and (C); all groups improved on fluency.

Smilansky claims that her results lend support to the notion that socio-dramatic play potentiates the ability of young children to "relate their scattered experiences and isolated concepts, utilize them, and convert them into new conceptual schemes." (page 149). In fact, what her results actually indicate is that tuition in socio-dramatic play leads to more self-initiated play on the part of the children; we do not know how this is related to their general verbal abilities (rather than their verbalisation during play) and it is not related to I.Q. Smilansky's greatest contribution was to draw attention to the possible important implications of the fact that socio-culturally deprived children engage in less socio-dramatic play than their better endowed peers; her own intervention programme was unable to produce unequivocal results regarding the value of intervention in socio-dramatic play by adults.

A study by Feitelson and Ross (1973) suggested that there are several aspects of development which may be associated with thematic play. Unlike Smilansky (1968) they do not regard play as being one stage in play development, but as an aspect of play behaviour which runs parallel to general development. However, since its maximum occurrence has been noted as around 4-6 years, they argue that intervention may be useful at this point to maximise its potential.

The skills and attitudes which they perceive as related to thematic play comprise: (i) socialisation the development of reciprocity; (ii) "mental health" - i.e. thematic play can serve as a catharsis in times of stress; (iii) "accumulative information" - they argue that in cognitive development, thematic play not only enables a child to develop a facility for handling representational sets, but also stimulates imaginative potential; (iv) thematic play is seen as the vehicle through which each child can develop his unique constellation of attitudes and personality traits. It is argued by Feitelson and Ross that: "When thematic play is not engaged in, immaterial for what reason, this avenue for exercising and reinforcing those skills and attitudes is unavailable. Other avenues may take over and compensate for this lack, but unless such alternative routes are available there is danger that the expected development of those skills and attitudes will be impaired in some way."

Their intervention study was aimed more specifically at attempting to establish a causal relationship between creativity, as measured by conventional creativity tests, and thematic play.

Using four groups of (5 year-old) children they purported to show that "creativity" measures improved most for a group who had received fantasy play tuition, relative to groups who had had either ordinary classroom tuition, music tuition, or simply access to play facilities. What actually happened was that the entire experimental group reached a homogeneous level of "creativity", whereas the classroom tutored group had a wider variance of scores on the post-tests. A perfectly reasonable interpretation is that fantasy play tuition actually stifles the ability of the bright child and enables the dull child to reach the level of mediocre, it cannot therefore be seen as of universal importance. On the contrary, if one is really

seeking to enhance creative skills, the highest levels of creativity are apparently achieved by offering the already creative child a general repertoire of information and skills.

Perhaps more important, however, Feitelson and Ross showed that the opportunity for modelling (upon an adult example) and the availability of "literal" play materials were essential for thematic play to flourish, a finding since replicated by Elder and Peterson (1978) - thus both the quantity and the quality of thematic play were superior for the play-tutored group after intervention ended. They argue that fantasy play may underlie specific "cognitive-structural" changes which will enhance the long-term intellectual development of the individual - as they say, their "wider web of conjecture hangs on thin strands" - indeed!

A later paper by Feitelson (1975) offers an interesting extension of some of the ideas put forward in the earlier paper by Feitelson and Ross (1973). She states a priori that additional training in make-believe play "seems to increase its benign influence and lead to better results in measured performance in a number of fields like language use (Smilansky, 1968), control of aggressive behaviour (Biblow, 1973) and creativity tests (Feitelson and Ross, 1973)". She espouses Welker's (1961) view that if optimal use is not made during early childhood of opportunity for exploration and play, an individual's level of cognitive organisation will be lower than his original potential. Furthermore, she argues that opportunities for play (and she is talking, in particular about representational play) are influenced predominantly by adult attitudes. A major finding is that children need literally representational toys in order to spark off a ludic theme. She argues that "the developmental course of

representational play is on a continuum from literal representation to a more and more non-literal mode", and that therefore, "access to literally representational toys seems a necessary step on the road to abstract thought". This is an elegant expression of the transition from representational to fantasy behaviours, and is some support for the exploratory-ludic analogy.

A study recently reported by Dansky (1980) examined the comparative effects of socio-dramatic play training (S), exploration training (E), and free-play (P) over a three week period with one-and-a-half intervention hours per week. In the S condition an adult played with groups of four children, enacting specific themes and using props; in the P condition children were given similar access to the props but the adult did not guide them in any way. In the E condition the emphasis was on the examination of objects; children were encouraged to note similarities and differences between objects, and to play games whereby one child described an object (without naming it) and the other children had to guess its identity. At post-testing children in the S condition scored significantly higher than the other two groups on 'imaginativeness' and 'verbal comprehension, production and organisation'; children in the E condition were able to give more detailed and accurate descriptions of a 'curiosity box' than the other two groups. Dansky argues that socio-dramatic play training has important consequences for children's performance on a range of cognitive type tasks, whereas the results of exploration training are more specific: "there are important differences in these two kinds of activity and in the impact which each can have on a child's development." (p. 45). This conclusion is a little premature in the absence of any evidence that the superior performance of the S group in cognitive skills could be

maintained, and is obscured by the absence of any theoretical framework. A conceptualisation of play which permits the separation of symbolic and manipulative play would predict different functions for each, and enable the formulation of more relevant test procedures.

A study by Rosen (1974) argued that "socio-dramatic play, being complex, activates the emotional, social and intellectual resources of the child." And thence, "... this activation stimulates the further development of these resources." By the way of illustrating this argument she devised an experiment in which an experimental group of disadvantaged kindergartners were given 40 days (one hour per day) of instruction and practice in socio-dramatic play. The experimenter brought toys, such as medical kits, firemen's and policemen's hats, etc., in order to stimulate specific role-taking behaviour.

There are a number of interesting findings about this study:

- (a) The intervention programme was more successful in teaching socio-dramatic play to children in day care than to children who spent only a half-day in kindergarten;
- (b) On the grounds that socio-dramatic play stimulates co-operative behaviour, Rosen hypothesised that, on a production task (with building blocks), the experimental group would be more co-operative than the controls - this was supported - and furthermore - the experimental group were more productive (in that they used a greater number of blocks);
- (c) When the experimental and control groups were required to solve problems, the experimental group gave a superior performance where the problems needed co-operation between subjects, although there was

no differences between groups when the best solution gave rise to competition between subjects;

(d) The experiences of the experimental group apparently led to an improvement in perceptual role-taking accuracy and in the accuracy of predicting the preferences or the wants of others.

Essentially Rosen seems to regard socio-dramatic play as providing excellent opportunity for what is basically social learning - in particular she indicates that socio-dramatic play enables the child to learn how to play his repertoire of skills to a variety of problems in co-operation with others.

The work of Saltz and Johnson (1974) in the U.S.A. was clearly inspired by Smilansky's example, and the recognition of the need for close evaluation of adult intervention in children's fantasy play. They employed a sophisticated experimental design over a four-month period with two experimental groups and two control groups: thematic fantasy play (TFP) and dimensionality (D) training were factors in a 2 x 2 factorial design. TEP training consisted of "systematic training in role enactment of action-type fairy tales" (e.g. The Three Pigs, Hansel and Gretel); in D training the children were given repeated opportunities to discuss social and physical objects in a group setting. Their report is one of the few which describes the difficulties involved in the training procedure; in particular they detail the difficulty which children had in enacting a theme rather than an event. After four months, the TFP groups showed a significant increase in spontaneous fantasy play during general nursery school activities. Both TFP and D training appear to have facilitated intellectual functioning (as measured by a battery of subtests from the WPPSI and ITPA), but on an "Interpersonal Perception Test" (IPT)

designed to measure the ability of young children to represent cognitively another's affective experience, TFP training appears to have resulted in improved scores. In a specially designed story-memory task, the RFP groups performed better than the control groups, although the subjects found this task extremely difficult. Performance on a further story-telling task suggested that the TFP trained children made more of an attempt to connect and integrate events in telling a story, showed superior general comprehension and used a significantly greater verbal output. In conclusion, Saltz and Johnson note that the beneficial effects of TFP training were achieved in a thoroughly enjoyable manner for children and teachers alike: " ... with the net effect that TFP proved to be a very encouraging, workable and promising intervention technique, one that deserves further use and study." (page 630).

The report of Saltz, Dixon and Johnson (1977) describes a partial replication of the original Saltz and Johnson (1974) study, and an analysis of the thematic-fantasy play employed in that experiment in an attempt to determine the variables that were critical to the results. They postulate four critical variables which are implicated:

- (a) "The dimension of fantasy - reality" - the appreciation of which enables a child to symbolise concrete experience;
- (b) "Time compression of causal relations" - through which comprehension of causality is enhanced;
- (c) "Play enactment" - which provides motoric mediation for the concrete to symbolic transition;
- (d) "Verbal stimulation" - which may well underlie cognitive facilitation produced by thematic fantasy play, particularly

disadvantaged children who may lack such stimulation at home.

Following the Saltz and Johnson (1974) study, four experimental training conditions were organised into a 2 x 2 experimental design, in which one main effect permitted evaluating training employing non-specific materials versus training employing more realistic materials. The second main effect permitted comparison of training which employed play enactment versus training that did not employ enactment of stories. Thus the four conditions were: A. Thematic fantasy play (both fantasy and play enactment); B. Fantasy discussion: children heard and discussed fairy tales but did not enact them; C. Socio-dramatic play: children enacted realistic events rather than fantasy stories; D. Control condition: children engaged in typical pre-school activities like cutting and pasting, categorising tasks etc.. Training took place in three fifteen-minute periods per week from November to May during the school terms. Their data show that the groups trained in play (groups A and C) had a higher mean I.Q. at the end of the school year than the other groups; the effect of fantasy was not significant. Play training also "increased ability to interpret sequential events (at least for children who scored above 70 - 80 I.Q. prior to the initiation of training programs); increased ability to distinguish reality from fantasy on the Taylor Pictorial Test; increased ability to delay impulsive behaviour under specified conditions; and increased ability to empathize with other children, at least under conditions of our testing procedure" (page 378). They argue that there are three main components in the "play" condition which have facilitated these effects: a specific break with the concrete environment; the expression of the motoric components of conceptualisation; and role change. The last of these,

they suggest, is more distinctive for the fantasy play condition and this accounts for the slight and consistent (though insignificant) superiority of the fantasy play group over the socio-dramatic play group. They argue that verbal stimulation per se was not a critical factor in the results obtained since all groups had roughly equivalent amounts of verbal interaction with adults, although they do postulate a possible interaction effect of verbal stimulation with play.

One aspect of the symbolic nature of fantasy play has been strongly emphasised by Golomb and Cornelius (1977). They report a study in which less than one week's training in fantasy play seemed to accelerate the acquisition of conservation skills. Drawing on the Piagetian notion of "reversibility" they argue that conservation skills require the ability to recognise that an "object (or substance) can change its form temporarily". Through the medium of fantasy play then, they deliberately manipulated scenes in which the experimenter required the child to specify the "real" properties of an object (e.g. a chair) following its use in a fantasy theme (e.g. where the chair had been used as a vehicle). They suggest that by drawing attention to the "reversible" role of objects, the child comprehends also the reversibility of physical form which is an integral part of conservation skills. Actually, this interpretation begs a number of questions since conservation skills seem to be dependent on a number of cues not even mentioned by Golomb and Cornelius (see for example, some of Donaldson's (1978) criticisms); in particular, it is well known that conservation "tests" are particularly susceptible to experimenter influence, and the failure of the authors to describe their testing procedures leaves us unable to evaluate their efficacy.

Furthermore, Bruner (1966) questions whether reversibility really is a component of conservation since, in an experiment using liquids and different shaped beakers, 75% of his subjects predicted reversibility correctly but did not conserve on a post-test. In fact, a subsequent attempt to replicate the Golomb and Cornelius study (see Chapter 7) has failed and both Fink (1976) and Smith (1978 - personal communication) also failed to find superior conservation skills in a group of children who had received fantasy play tuition over a period of months, relative to a control group who had been trained in general skills which incorporated an understanding of object properties. The results of the Golomb and Cornelius study may therefore be regarded with some reservation.

Smith and Sydall (1977) report an intervention study which took place during the summer months (i.e. not at school), in which they controlled extremely carefully for the amount of child-tutor interaction in a play-tutored group and a skills-tutored group (40 minute sessions, 3 times per week over 5 weeks). Using five measure of skills (Reynell Language Scale, Caldwell Inventory, Draw-a-man, Dog and Bone, Role-taking), they found no differences between the two groups on the post-tests, although the play tutored group engaged in more group activity and, predictably, more spontaneous fantasy play. A subsequent study by Smith, Dalglish and Herzmark (1978) replicated these results in two Sheffield nursery schools which catered mainly for socio-economically disadvantaged children. The results from these two studies support the contention of the authors that the child's greatest intellectual benefit is derived from interaction per se with the adult rather than the specifically playful nature of the interaction. They argue that their results differ from those of Saltz

et al. (1977) because: (i) the intervention tutors and testers were ignorant of the experimental hypotheses, thus decreasing the likelihood of obtaining a 'Rosenthal' effect; and (ii) they controlled as far as possible for the quantity and quality of verbal interaction.

6.2 The Experimental study of symbolic play: correlational data

The nature of the relationship between fantasy play and verbal skills has been examined by several authors. Both Smilansky (1968) and Freyberg (1973) reported a relationship between verbal ability and fantasy play. Tizard, Philps and Plewis (1976) found a low positive correlation between frequency of symbolic play and raw scores on the Reynell Developmental Language Scales (although this correlation disappeared when standardised measures were used). Hutt (1979c) has shown that even disadvantaged pre-school children use syntactically more sophisticated language during fantasy play than in their daily discourse. It can be suggested, therefore, that any possible relationship between I.Q. and fantasy play on the one hand, or between creativity and fantasy play on the other, may be due to the facilitatory effects of verbal skills.

Various authors have pointed to a relationship between fantasy play and 'creativity'. Singer (1973) cites a considerable body of evidence indicating both that the amount of reported fantasy play in childhood is correlated with adult creative achievement, and that there is an association between fantasy play and the kinds of divergent processes proposed by Guilford (1967) and Wallach and Kogan (1966). The nature of his data renders his argument speculative, but essentially he is postulating that the imaginative element in fantasy play is related to the ability of removing oneself

from intellectual or artistic constraints; thus, he argues, if fantasy play skills are enhanced in early childhood there should be some beneficial effects on creative ability in later life.

Lieberman's (1977) thesis is similar to Singer's, and her main claim is that "playfulness is an ingredient of the creative individual's cognitive style" (p.108), and that playfulness is an attribute of mind with a distinctive, intrinsic (possibly neuro-biological) motivational force. Fantasy play provides an opportunity for the child to recombine and reorganise familiar materials and ideas, and these same abilities are also characteristic of creativity.

Smith (1977) has also shown that most play takes place within a social context and thus indicates that fantasy play cannot realistically be divorced from social play. As yet, there is no evidence which specifically links sociability and fantasy play, and the question of whether the solitary child is more or less likely to engage in fantasy play than his more sociable peers has not been answered. Intuitively, it may seem that more sociable children may more readily absorb themselves in fantasy play, and certainly, it has been shown that children playing with each other did so for longer periods of time than when they played alone at home (Davie, Forrest, Hutt, Mason, Vincent & Ward, 1975).

Finally, various studies have indicated that social class may be an important variable affecting fantasy play (Smith, 1978; Tizard et al., 1976). It appears that different socio-economic groups may reach peak levels of interest in fantasy play at different ages: Smilansky (1968) notes that pre-school middle-class Israeli children engaged in more fantasy play than an equivalent age group of immigrant working-class children although statistics were not applied to

estimate the significance of this result. She argued that this was because the environment of the middle-class group was both stimulating and supportive, whereas the environment of the socio-economically disadvantaged group was alien to fantasy play. Eifermann (1971) refuted this suggestion by her finding that lower-class groups reach peak levels of fantasy play at a later age (6 - 9 years), and she suggests that lower-class children have at least as much fantasy play experience as their middle-class counterparts by the age of ten years. Rubin, Maioni and Hornung (1976) report no social class differences in dramatic play for an American group.

One of the less explicable observations of symbolic play concerns the extent of individual differences: some children are known to be highly imaginative and to engage in much fantasy play, others are observed to play in this manner hardly at all. What may contribute to these differences? If fantasy play is facilitated by verbal proficiency it may be supposed that children who are superior in non-linguistic skills, such as spatial ability, are less likely to engage in this form of play. Indeed, Rubin and Maioni (1975) found a positive correlation between incidence of dramatic play and spatial egocentrism. Their results should, however, be interpreted with some caution since they have inappropriately used a parametric statistical analysis of their data (the mean incidence of dramatic play for their sample was 2.75 minutes, $SD = 2.44$ minutes).

6.3 General Conclusions

One of the problems in interpreting studies of children's symbolic play has been the inadequacy of classification. The above review suggests that the making of a distinction between imitation and fantasy is theoretically valid, and may have important implications. In

particular, this distinction provides an analogy with the 'exploration/play' distinction described in Chapters 3-5, and therefore suggests that imitation is associated with learning behavioural patterns, whereas fantasy play is more evidently ludic. On these grounds, one would expect fantasy play to be more associated with the creative processes alluded to by Singer (1973) and Lieberman (1977).

Nonetheless it is evident that there exists a wide variety of claims concerning the importance of symbolic play, despite the fact that many of the empirical data are equivocal in their support for the contention that such play serves a unique role in development. The following chapters include a description of experimental work which considers the hypothesis that the developmental correlates of symbolic play are not unique, and that intervention in such play may have results which are dependent solely on the intervention effects.

CHAPTER 7

EFFECTS OF INTERVENTION IN SYMBOLIC PLAY

A DES report in 1976 specifically encouraged teachers to promote symbolic play in pre-school environments because of its "educational importance". Just how strong the grounds were for this assumption have recently been questioned. Certainly, there were some promising early reports coming from the U.S. (reviewed in chapter 5) in which it was claimed that training in fantasy play facilitated language, social co-operation, restraint of impulsivity, conservation skills, and general intellectual ability. However, recent reports by Smith, Dalgleish and Herzmark (1978), and Smith and Sydall (1978) have demonstrated that training in fantasy play is not necessarily any more beneficial than non-play tutoring. This chapter reports on two intervention studies in children's play: the first is an attempt to replicate the results of Golomb and Cornelius (1977) (that a certain type of symbolic play training accelerates the acquisition of conservation skills), the second reports the effects of a longer term intervention programme on a range of variables.

Study 5 Training conservation during symbolic play

The results of Golomb and Cornelius (1977) show an increase in conservation of substance scores of four year old children following a series of 6 x 15 minute play sessions over a 3 day period. During each of these play sessions, the experimenter challenged the child to recognise and articulate the dual nature of the objects used in play; the same adult played with and tested the child on each occasions. The authors state that during symbolic play children use an "intuitive form of reversibility (p.247) in which they "transform objects and roles while simultaneously maintaining their original identity and function";

they then define conservation as "cognition that certain properties remain invariant despite certain transformations". Therefore, they argue, if a child is encouraged to an awareness of his intuitive reversibility operations, he will be able to apply these skills successfully to formal conservation testing.

In making these statements, Golomb and Cornelius have restricted the cognitive requirements which Piaget originally attributed to conservation skills (Piaget and Inhelder, 1966) by focusing solely on inversion-negation reversibility. Piaget and Inhelder (1966) state that children who express a belief in conservation of substance after transformation (for example, rolling of a ball of playdoh into a sausage shape) do often explain their belief in terms of the reversibility of the operation; that is, the children accept that the material can be restored to its original forms. This is inversion-negation reversibility of the type described by Golomb and Cornelius. However, this type of reversibility does not require the child to assume that the amount of playdoh remains constant under the transformation; the belief that the amount remains invariant is expressed in terms reversibility via reciprocity. That is, the child should express the belief that the amount remains constant because one effect of the transformation (for example, the increase in length of the playdoh) compensates for the other effect (for example, decrease in width). Piaget and Inhelder (1966) argue that it is the successive use of both type of reversibility (that substance can be restored following transformation, plus the recognition that the two effects of transformation can balance one another out) that underlies the concept of identity which is vital to conservation acquisition.

Bruner (1966) and Lovell and Ogilvie (1960) have observed that children who have the operation of reversibility via inversion-negation do not necessarily have conservation of substance (that is, they believe that there is a change in the amount of playdoh when it is rolled into a sausage which is negated when it is reshaped into a ball). They argue that inversion-negation reversibility is a necessary, but not sufficient, condition for the attainment of conservation of substance.

There are then, both theoretical and methodological grounds for attempting to replicate the Golomb and Cornelius (1977) study. At a theoretical level, their finding that a training procedure based solely on inversion-negation, is sufficient to induce conservation skills, is inconsistent with Piagetian theory and the findings of other authors. At a methodological level, they are to be criticised for their failure to dissociate the test procedures from the training procedures: a child who, on three successive days, has had to explain to an experimenter that an object can have one role in play and another in reality, may well feel that the experimenter requires conservation judgements of the type that two things are the same (despite the fact that the child "knows" them to be different).

This experiment therefore describes an attempt to replicate the Golomb and Cornelius (1977) study as nearly as possible, except that different adults are used for intervention and testing. Also, there is an additional experimental group who have the same symbolic play sessions except that there are no challenges from the experimenter concerning the roles of particular objects: this enables the possible testing of the hypothesis that the symbolic play per se, rather than its specific training element (the challenge), led to

the improvement in conservation scores. (An experiment reported by Fink (1975) failed to find improvements in conservation following symbolic play training). In addition all children were tested on class inclusion skills (another test of concrete operation functioning, Piaget 1972) to provide a possible evaluation of the amelioration of children's test scores by virtue of their familiarity with the adults involved. Since class inclusion requires the ability to group objects on the basis of abstract invariants, it was felt that reversibility training would play no part in the expression of these skills.

METHOD

Subjects were 42 children, age range 3 years 9 months to 4 years 9 months, from a variety of social backgrounds. The children were allocated to two experimental groups (E1 and E2) and a control group (C), balanced for age and sex.

Procedure. The experiment was conducted over 5 consecutive days. On all occasions children were seen individually in a room within the pre-school. Two adults acted as play tutors, and a third assisted with testing.

Day 1 - Pre-testing. Two tests of conservation of substance (solid and liquid) and a test of class inclusion were administered (scripts for testing are given in Appendix C). The scoring system is shown in Table 7.1, and is the same as that in the Golomb and Cornelius (1977) study: there was a possible range of 0-4 on the conservation tests, and 0-1 on the class inclusion.

Table 7.1 Scoring for conservation and class inclusion

0 - incorrect conservation judgement

- 1 - correct judgement, not accompanied by adequate explanation
- 2 - correct judgement, accompanied by adequate explanation
(reversal by inversion negation or reciprocity)
- 0 - incorrect class inclusion
- 1 - correct class inclusion

Days 2-4 On each of these days each child in the two experimental groups were seen for 15 ± 3 minutes. Basic equipment was introduced by the experimenter, who suggested the initial theme of play. During play the children's suggestions and ideas were followed, but the experimenter ensured continuation of basic themes.

On day 2, playdoh was ^Sup_Led to make a picnic; the players drove to the mountain or seaside in a car made from chairs. On day 3, a set of soft toys picked strawberries (pebbles or beads), and then went horse-riding on empty egg-boxes. On day 4, the same soft toys went boating and shopping; the adult took the role of shopkeeper and sold an assortment of objects (woolly hat, sponge, socks) as either food or pets.

Children in the E1 group were challenged at appropriate moments during play about the dual nature of the objects being used. For example, during the picnic scene, the adult might ask for some food, and when offered playdoh would enquire how it could be food and playdoh at once. On each day there were two such challenges. Children in the E2 group played the same games, but without the challenges. The control group continued with normal nursery activities during days 2 - 4.

Day 5 - Post-testing. The post-testing followed the same procedure as pre-testing. Since many children expressed dismay at this point (Oh no, not these again") they were asked to think carefully about

their answers, and were told that it did not matter if they answered differently from the previous occasion.

RESULTS

Preliminary analysis revealed no differences between the results obtained by the two adult play tutors or the three testers. Test results reflect the consensus judgement of all 3 testers, one of whom tested the child, the other 2 of whom listened to a recorded version. No child included in the study gave adequate explanation at pre-testing for his conservation judgements, and only 3 children (one allocated to each group) gave 2 correct judgements; 8 children made one correct judgement at pre-testing (3 each were allocated to groups E1 and E2; 2 were allocated to C), the remainder of children scored zero. No child made a correct class inclusion judgement at pre-testing; one child (from E2) made 2 correct judgements at post-testing. Twelve children made at least one correct judgement at post-testing; these included the 11 children who had made such judgements at pre-testing, and a child from E1. The same 3 children made 2 correct judgements; and 3 further children had improved from one correct judgement to two. No adequate explanations were given at post-testing. (These results are summarised in Table 7.2)

Table 7.2 Summary of conservation scores showing the number of children in each scoring category

Score	<u>Pre-test</u>			<u>Post-test</u>		
	0	1	2	0	1	2
E1	10	3	1	9	4	1
E2	10	3	1	10	2	2
C	11	2	1	11	1	2
TOTAL	31	8	3	30	7	5

A chi-squared test revealed no significant relationship between experimental group and scores at post-testing ($x^2 = 4.25$, 4df, n.s.). Since the groups were matched at pre-testing, and there is no significant improvement in the scores of any of the groups, this finding suggests that the intervention in symbolic play during this experiment had no effect whatsoever on conservation judgements.

In order to test the possible criticism that the children's conservation judgements were affected by the linguistic structure of the testing procedure (Donaldson, 1978), a sample of children ($n = 12$) was asked to put enough water in the gas jar to fill the shorter, fatter jam-jars. They all filled the gas jar to the same level as the top of the short jar, and were surprised at the discrepancy when the water was transferred. Furthermore, although such comments were not deliberately solicited, a small number of children did comment how the playdoh 'grew' into a sausage when rolled out, and was made 'smaller' when squeezed into a ball; they thereby confirmed the contention of Bruner (1966) and Lovell and Ogilvie (1960) that they had a concept of inversion-negation reversibility but were unable to conserve.

DISCUSSION

This failure to replicate the experiment described by Golomb and Cornelius (1977) is consistent with theoretical prediction; it does, however raise the question of why the two sets of results should be so markedly different. The fact that the Golomb and Cornelius study used a single adult to play with and test the children is apparently not the crucial factor since another recently reported 'failure to replicate' also used a single adult (Guthrie and Hudson, 1979).

Aspects of the Golomb and Cornelius study which are not available from their experimental report are (a) the style of their relationship with the children, and (b) the extent of prompting required to elicit explanations from the children of the transformation of objects during play. The former of these is, of course, undefinable but cannot be considered as without influence on children's responses to testing. The latter factor, though, bears some further consideration.

In this study, children were required to state both the "real life" and the "pretend" nature of the object, and then to give some explanation of how it could be "two things at the same time". A common answer was of the type that we were pretending that the box was a boat, and the child was not then prompted further. However, it can be conjectured that if the child were asked "does the box change when we pretend it's a boat?" that the child would be more likely to focus on the idea of invariance of the properties of objects despite a symbolic transformation. The idea that transformations can preserve the identity of objects might then be more easily generalized to conservation of substance despite transformation of shape. That is, a child confronted with an adult who had insisted on the articulation of the invariance of an object during 'pretend' play, would generalise this type of response when being tested by that adult subsequently.

In conclusion, it can only be said that intervention in symbolic play involving challenge of the transformations involved does not necessarily facilitate the expression of conservation skills. The balance of arguments is somewhat against such a relationship and the

outcome of the Golomb and Cornelius (1977) study is therefore probably best regarded as one of life's flukes.

Study 6 Long-term intervention in children's symbolic play

In Chapter 6, it was suggested that symbolic play could be classified on a dimension ranging from imitation (representational play) to fantasy (thematic, imaginative play), and that this sub-classification was in parallel to the exploratory-ludic dimension in manipulative play. Thus, during representational play a child is expressing knowledge of particular events (or sequences of events) and during fantasy play is using that knowledge in original and creative ways. Since standard intelligence tests require a child both to express information and to use his knowledge, it is not surprising that training intervention in children's symbolic play enhances performance on these types of test. Whether such intervention is uniquely useful is in doubt; the evidence from the Head Start programmes in the U.S. suggests that children's I.Q. can be enhanced by a variety of intervention procedures (Zigler and Trickett, 1978), and that the degree of benefit is greatly dependent on the commitment and emphasis of the staff (Beller, 1973).

This study is an attempt to assess the effects of different kinds of intervention technique, with specific reference to the hypothesis that through symbolic play children acquire appropriate cognitive skills which optimise their performance on intelligence tests. Because the nature of the intervention described (working with small groups of children on symbolic play themes) is similar to that in the Saltz, Dixon and Johnson (1977) study, an attempt is also made to replicate their findings that intervention in symbolic play enhanced

creativity and social responsibility.

METHOD

Subjects were 28 children (age range 3 years 6 months - 4 years 6 months at time of pre-testing) representing a cross-section of social-class groups. They were drawn from three different pre-school establishments, and each experimental group contained a representative sample.

Procedure. The intervention took place during the course of the spring and summer school terms (1978) and within the pre-schools' timetables. This comprised a total of 16 weeks intervention (allowing a fortnight for testing at the beginning and end), during which time each group received an average of $1\frac{1}{2}$ hrs. specialised adult contact per week.

Group A were taken on fortnightly outings to places of interest (a pottery, a fire-station, a hospital, a garage, a wildlife park, a quarry, and a shop). During these outings the children's attention was drawn to the type of work that the adults were doing, and the materials with which they worked. These outings were intended to provide the children with novel information which was then followed up in three symbolic play sessions. The play sessions were 15 ± 3 minutes, and during these the play tutor used the first session to encourage the children to imitate the roles they had seen, and in the subsequent sessions encouraged them to develop fantasy themes around these roles.

Group B were taken on the same outings, but subsequent sessions, while related to the outings, were based on general pre-school activities (collage, paintings, etc.). The adult made specific efforts to draw the children's attention to the properties of the materials they were

working with, and to discuss issues related to the outing.

Group C had an equivalent amount of adult contact divided between symbolic play sessions (which were similar to those of Group A) and intervention in general pre-school activities.

The mode of intervention was deliberately "child-centred". Saltz and Johnson (1974) have documented the difficulty of sustaining a fantasy play theme with a group of children and the intervention sessions were therefore usually conducted with small groups of children (2-6).

Tests and Measures. All children were tested on measures of general cognitive ability and creativity before the initiation of the intervention. Teachers provided measures of sociability and imaginativeness by using Herbert's Social Behaviour Rating Scale (Herbert, 1974). These tests were administered again at the end of the summer term. Testing was done in the children's homes.

1. General Cognitive Ability was measured using the McCarthy Scale of Children's Abilities. The General Cognitive Index (GCI) on this scale also provides separate scores on verbal ability and perceptual performance/quantitative ability scales.

2. Creativity was assessed by fluency and originality scores on the Alternative Uses (5 items) and Pattern Meanings (4 items) tests of the Wallach and Kogan (1965) test battery. Creativity scores were derived by giving one point for each response, and an additional one point for each unique response.

3. Imaginativeness. Herbert's Social Behaviour Rating Scale (Herbert, 1974) asks the teacher (inter alia) to respond to a question about each child "Is she/he practical minded or imaginative?" on a five-point

scale:

x	x	x	x	x
shows little imagination especially in creative activities		occasional flashes of imagination, but not outstanding		very imaginative

Responses on this question were scored from 1-5, using 5 as the "very imaginative" score.

4. Sociability. A rating of sociability was also derived from the SBRS; this rating is based on teachers' responses to seven questions (each on a five-point scale) and has been validated in other studies (Herbert, 1974).

5. Symbolic play. All children were observed for one hour (3 x 20 minute sessions on different days). A time-sampling convention was adopted whereby each child was observed at 30 second intervals; and note was made whether he was engaged in symbolic play. The percentage of observations with symbolic play were used as an estimate of the percentage of total time each child spent in this type of activity (Tyler, 1978).

RESULTS

Data from all the assessments were analysed using a 2-way ANOVA design: experimental condition (3 independent groups) x time (repeated measures at pre- and post-testing). The means and standard deviations for each set of scores are given in Table 7.3; ANOVA tables are given in Tables 7.4 - 7.9. (The skewed distribution of the times spent in fantasy play render these data unsuitable for parametric analysis; these data were therefore analysed rather differently.)

1. Cognitive Abilities. As predicted, all the groups showed a significant improvement of about 4 points on the General Cognitive

Index of the McCarthy Scales ($F = 8.3$; $df = 1.23$; $p < .01$); there was no difference between the groups. The improvement on the verbal sub-scale was not as marked as the improvement on the perceptual abilities sub-scale.

2. Creativity. Creativity scores improved for all 3 groups ($F = 31.7$; $df = 2.25$; $p < .01$), but there was no difference between the groups.

3. Imaginativeness. The teachers' ratings of imaginativeness in the children increased for all subjects during the intervention period ($F = 9.8$; $df = 1.25$; $p < .01$). Again, there was no significant difference between the groups.

4. Sociability. There was no significant change in the teachers' ratings of sociability.

5. Symbolic play. Although the data in Table 7.3 indicate a general trend of increased time spent in symbolic play, only Group C show a statistically significant increase (Wilcoxon $T = 4$, $n = 10$, p (2-tailed) $< .05$).

The relationships between the measures were evaluated by calculating the inter-correlations among them. The amount of time spent in symbolic play at post-testing was positively correlated with the amount of symbolic play at pre-testing (Spearman rank correlation = 0.489, $n = 28$, p (2-tailed) $< .02$); it did not correlate significantly with any other measures. The remaining measures all showed the expected correlations between pre- and post-test scores, and the McCarthy scales also showed significant inter-correlations. The only other significant correlations were between the teachers' ratings of imaginativeness and the GCI and verbal ability scores. Actual values are shown in Table 7.10.

DISCUSSION

Although the brief of the present study was somewhat narrower than that either of Saltz, Dixon and Johnson (1977) or Smith and Sydall (1978) the results do tend to support those of the latter authors, thus lending credence to the contention that increases in standardised test scores, particularly IQ, can be achieved equally successfully by any type of intervention in the pre-school. The difference between educational techniques appears to be far less important than the difference between intensive educational intervention and no intervention at all.

In accordance with the hypotheses of the study, it had been intended to test the children to establish what aspects of the outings they had remembered. Unfortunately, owing to the absence of many children at the end of the summer term this proved impossible. However, it is the author's impression that the outings (for Groups A and B) were a much richer source of information than related nursery activities (for Group C). Furthermore, there was no obvious indication that Group B, where outings were followed up by general nursery activities rather than symbolic play, learned any less than their Group A counterparts. It is likely, then, that the effectiveness with which new information is consolidated is more a function of the presentation of the information, than the way in which it is followed up.

A study by Dash, Foy and Hutt (1979) has shown that children who are in full-time attendance at nursery schools engage in proportionately more fantasy play than their part-time peers. They argued that this is because both groups attempt to maximise their use of nursery facilities but that the full-time group are left with

greater opportunity for displacement activity (i.e. fantasy play) when the work is done. They support this argument with evidence that both groups of children progress equally well on a set of standardised tests. It seems, therefore, that the 'deficit' of the part-time children is not reflected in their social or intellectual abilities.

It is nonetheless evident from the plethora of pre-school intervention studies which have been implemented that any well planned tutoring sequence which requires active participation by the children involved, can lead to improved performance. What is in contention is the value of 'play'. Schwartzman (1978) had drawn an especially telling analogy between what she believes to be the equally faulty reasoning of the verbal deprivation theorists and the play deprivation theorists. Relying heavily on Labov's (1972) criticism of the early work of Bernstein (e.g. 1966), Bereiter and Engelmann (1966) and others, she points out that since fantasy play intervention programmes are based on much the same inverted logic as many of the early Head Start programmes they are bound to fail in the long term. A synopsis of her arguments can be made as follows:

- "1. The lower class child's play response to a formal and threatening situation is used to demonstrate his lack of imaginative capacities or his play deficit.
2. It is suggested that this play deficit is a cause of the lower class child's poor performance in school.
3. Since middle class children do better in school, middle class play habits are seen to be necessary for learning.
4. Class and ethnic differences in expressions of imagination are equated with differences in the capacity for logical analysis, verbal communication and social skills.

5. Teaching the child to mimic certain play patterns as displayed by middle-class children and adult play tutors, is seen as helping him to improve his cognitive, verbal and social functioning.

6. Children who learn these play patterns are then said to have improved their imaginative, cognitive, verbal and social skills, and it suggested that they will do better in the years to follow." (Schwartzman, 1978, pp.122-123).

Schwartzman's suggestion that psychologists may actually have created "by the use of inappropriate theories and/or methods", the idea of a play deprivation syndrome, cannot be lightly dismissed. Despite the fact that we know children's 'performance' can be improved by intervention, we lack strong evidence that children within a given culture actually suffer any deficit if they engage in little play relative to their peers.

The following chapter therefore examines some of the developmental correlates of play in order to test the hypothesis that children who engage in little or no symbolic play are in some way at a disadvantage to their peer group.

Table 7.3 Summary of pre- and post-intervention measures

Experimental group Test Measures	Group A		Group B		Group C	
	pre	post	pre	post	pre	post
GCI	111.6 ± 13.5	115.6 ± 8.8	107.5 ± 20.6	112.1 ± 20.2	104 ± 15.6	108.4 ± 13
Verbal ability	53.9 ± 10.3	56.4 ± 6.5	53.7 ± 11.9	55.3 ± 14.8	51.1 ± 11.2	53.9 ± 10.8
Perceptual skills	115.8 ± 14.2	117.4 ± 11.9	107.6 ± 18.8	114.7 ± 18.7	105.8 ± 13.6	109.4 ± 8.9
Creativity	10.5 ± 8	16.4 ± 8	10.7 ± 5.1	18.1 ± 6	18.1 ± 4.3	22.1 ± 6.9
Imaginativeness	3 ± 0.9	3 ± 0.7	3.4 ± 1.2	3.9 ± 0.9	2.8 ± 1.3	3.6 ± 0.7
Extraversion	26.6 ± 3	25.5 ± 3.6	26.7 ± 3.2	29.2 ± 2.3	25.1 ± 2.5	26.7 ± 2.6
% fantasy play	7.6 ± 5.9	20.9 ± 17.6	19.5 ± 19	23.3 ± 10.8	9.6 ± 12.9	12.4 ± 7.9

Source	SOS	df	MS	F
<u>Between groups</u>				
E: (experimental condition)	506.8	2	253.4	0.55, n.s.
S's within groups	11,500.9	25	460.0	
<u>Within groups</u>				
T (time)	262.4	1	262.4	8.3, p<.01
E x T	1.2	2	0.6	n.s.
T x S's within groups	791.2	25	31.6	

Table 7.5 ANOVA for verbal scale scores

Source	SOS	df	MS	F
<u>Between groups</u>				
E	71	2	35.5	.16, n.s.
S's within groups	5,526	25	221	
<u>Within groups</u>				
T	74.8	1	74.8	2.9, n.s.
E x T	3.3	2	1.6	n.s.
T x S's within groups	644.9	25	25.8	

Table 7.6 ANOVA for perceptual ability scores

Source	SOS	df	MS	F
<u>Between groups</u>				
E	765.2	2	382.6	0.96, n.s.
S's within groups	9,971.3	25		
<u>Within groups</u>				
T	238.6	1	238.6	6.9, p<.05
E x T	71	2	35.5	1.0, n.s.
T x S's within groups	862.8	25	34.5	

Source	SOS	df	MS	F
<u>Between groups</u>				
E	484.1	2	242.1	3.3, n.s.
S's within groups	1825	25	73	
<u>Within groups</u>				
T	466.8	1	466.8	31.7, p<.01
E x T	27.7	2	13.9	0.9, n.s.
T x S's within groups	368	25	14.7	

Table 7.8 ANOVA for imaginativeness scores

Source	SOS	df	MS	F
<u>Between groups</u>				
E	4.5	2	2.2	1.3, n.s.
S's within groups	43	25	1.7	
<u>Within groups</u>				
T	2.3	1	2.3	9.8, p<.01
E x T	1.4	2	0.7	3 , n.s.
T x S's within groups	5.9	25	.2	

Table 7.9 ANOVA for sociability scores

Source	SOS	df	MS	F
<u>Between groups</u>				
E	48.7	2	24.3	2.2, n.s.
S's within groups	276.7	25	11.1	
<u>Within groups</u>				
T	14	1	14	2.3, n.s.
E x T	33.2	2	16.6	2.8, n.s.
T s S's within groups	150.7	25	6	

Table 7.10 Product-moment correlations between measures

	1	2	3	4	5	6	7	8	9	10	11	12
GCI	Pre-test	1	-									
	Post-test	2	.89*	-								
Verbal scores	Pre-test	3	.92*	.74*	-							
	Post-test	4	.86*	.92*	.79*	-						
Perceptual ability scores	Pre-test	5	.87*	.87*	.64*	.76*	-					
	Post-test	6	.79*	.88*	.6*	.68*	.85*	-				
Creativity	Pre-test	7	.05	-.06	.03	.07	.09	-.2	-			
	Post-test	8	0	-.1	.1	.12	-.07	-.3	.71*	-		
Imaginativeness	Pre-test	9	.52*	.54*	.46	.56*	.43	.43	-.27	-.07	-	
	Post-test	10	.45	.5	.44	.56*	.38	.39	-.16	.05	.77*	-
Sociability	Pre-test	11	.38	.3	.24	.39	.45	.21	-.03	-.11	.39	-
	Post-test	12	.14	.01	.07	.05	.14	.05	.08	-.05	.18	.28

* p(2-tailed) <.01

CHAPTER 8

DEVELOPMENTAL CORRELATES OF SYMBOLIC PLAY

Chapters 5 and 6 examined the experimental evidence that intervention in children's symbolic play had unique and significant effects on their development. Claims have been made for the effects of such intervention on intelligence (Smilansky, 1968; Saltz and Johnson, 1974; Saltz, Dixon and Sydall, 1979), on creativity and divergent thinking (Singer, 1973; Feitelson, 1975; Saltz et al 1974, 1977) and on social skills (Smith, 1977; Iannotti, 1978; Burns and Brainerd, 1981). Under critical examination such effects appear not to be unique, but a stronger case would be made for the validity of such intervention if it could be demonstrated that children who engage in much symbolic play are in some way different from children who prefer other forms of play.

Study 7 Cognitive and personality correlates of symbolic play.

The relationship between levels of symbolic play and IQ is by no means clear. Smilansky (1968) expressed uncertainty: "We came to the conclusion that intelligence is probably not a main variable affecting the socio-dramatic play of children" (p.40); but Johnson (1976) reports low correlations between social fantasy play and verbal intelligence scores (PPVT) which just attain significance ($p = .05$). Sherrod and Singer (1977) argue strongly that levels of fantasy play are correlated with intelligence, but rely largely on anecdotal evidence and the results of intervention studies. Both Smilansky (1968) and Freyverg (1973) report a positive correlation between verbal ability (presumed to be a component of IQ) and fantasy play. The findings of Tizard, Philips and Plewis (1976) and Hutt (1979c) (reported in Chapter 6) lend support to such a relationship and raise a question

as to whether children who engage in high levels of fantasy play do so at the expense of developing skills in other areas. If fantasy play is verbally oriented, it is possible that children who spent little of their time in such activity are actually developing non-verbal, spatial-type skills. The report of Rubin and Maioni (1975) that children showing high levels of dramatic play tended to be more spatially egocentric than their peers is tentative support for this view.

This study reports an attempt to examine the cognitive correlates of fantasy play, and also to examine some of the social factors which may contribute to its incidence (for example, sociability and social class; see Chapter 6).

METHOD

Subjects were 42 children aged 3-4 years (mean age = 3 years 10 months) drawn from two playgroups and three nursery schools. One child was subsequently eliminated from the analysis due to incomplete test results.

Test and Measures

1. General Cognitive Ability (GCI) was measured using the McCarthy Scale of Children's Abilities (1970).
2. Verbal Ability was assessed using the verbal scale of the GCI.
3. Spatial Ability was measured using the score from the Koh's Blocks Design Test of the WPPSI.
4. Creativity was assessed by using fluency and originality scores on the Alternative Uses (5 items) and Pattern Meanings (4 items) tests of the Wallach and Kogan (1966) battery. Creativity scores were derived by giving one point for each response, and two points for a unique

response.

5. Sociability was assessed from teachers' ratings using the SBRS (Herbert, 1974).

The SBRS was also used to obtain a rating of imaginativeness (as in Study 6).

6. Social Class. These data were obtained from school reports.

Those children from socio-economic classes I, II and III (non-manual) (Registrar General's Classification) were classified as middle-class; those from III (manual), IV and V as lower-class.

7. Amount of fantasy play. This was estimated using an instantaneous time scan sampling method and a simple behavioural check list of three categories: 'fantasy play', 'representational play', and 'other'. Each child was observed for 3, twenty-minute 'free play' sessions on different days; the observer noting on the check list at precise one-minute intervals what the child was doing. Tyler (1979) had demonstrated that this should yield an accurate estimate of percentage time spent in each activity if bout lengths are greater than half a minute.

'Fantasy play' was defined as an activity which had an element of "let's pretend" during which a child used objects to represent something quite different (e.g. a ruler as a gun, or a rag as a doll) and/or the child was taking an imaginary role (e.g. cowboy or mother); representational play was confined to activities where miniatures or replicas (e.g. dolls or cars) were used, or when such objects were specifically made - thus, a child who made sausages out of plasticine was engaging in representational play, but if this was part of a theme in which he was preparing a meal it was defined as fantasy play. In practice, this was sometimes a difficult distinction to make, but where there was any doubt the definition of fantasy play was recorded. The

decision to exclude representational play was made on the grounds that this is what some authors would regard as immature fantasy play (e.g. Fein, 1975), and it is hypothesized that cognitive abilities would be linked with more sophisticated fantasy.

RESULTS

The distribution of fantasy play scores in our sample was heavily skewed with ten children having scores of 0% fantasy play (see Figure 8.1); the median score was 7.5%. The analysis of class differences did not yield significant differences in the amount of fantasy play recorded (Mann-Whitney $U = 186$, $z = 0.55$; N (middle-class) = 23, N (working-class) = 18).

The whole sample was divided into two groups at the median score of amount of fantasy play: no significant differences were found between the two groups on any recorded variables. Since it was possible that this resulted from the nature of the distribution it was decided to examine two groups who were clearly distinguished from each other on both fantasy play and imaginativeness. Thus, those children who scored above the median on fantasy play scores and who were rated as highly imaginative (score 4 or 5) by their teachers, were classified as the "high fantasy" group ($n = 7$). This group was then matched for sex and social class with a group of children with fantasy play scores of below 7.5% and a score of 1 or 2 on the imaginativeness rating. The means and standard deviations of each set of scores together with associated values of t (independent samples) are shown in Table 8.1.

These results from the carefully matched 'extreme' samples, confirm the earlier finding from the entire sample that there is no significant relationship between the amount of fantasy play and scores on the standardised tests used in this study.

Table 8.1

SUMMARY OF SCORES FOR HIGH AND LOW FANTASY PLAY GROUPS

Experimental group Test measure	high fantasy n = 7	low fantasy n = 7	t (df = 12)
McCarthy GCI	112 \pm 19.3	115 \pm 12	0.34 n.s.
verbal score	54 \pm 11.4	55 \pm 8.8	0.19 n.s.
Koh's blocks	8.3 \pm 2.8	8.7 \pm 3.4	0.24 n.s.
Sociability	27 \pm 3.2	26 \pm 4.4	0.62 n.s.
Creativity	7 \pm 3.7	8.4 \pm 4.2	0.52 n.s.

DISCUSSION

The results are quite clear in their demonstration that, in the population studied, there is a singular lack of association between the amount of fantasy play and either general cognitive ability or 'creative' skills; nor is there any relationship between fantasy play and the more specific aspects of cognitive functions such as verbal or spatial ability. Furthermore, the amount of recorded fantasy play is not shown to be related to social extraversion factors.

In the face of these negative results, it becomes imperative to subject the results attributed to fantasy play intervention to even closer scrutiny. Both Smilansky (1968) and Feitelson and Ross (1973)

have demonstrated that the amount of fantasy play in which a child engages can be increased by tuition; Feitelson and Ross (1973) make the additional point that such tuition should include both adequate models and play materials - in the absence of one of these the increase in play will be of the mechanical, stereotypic variety.

Saltz et al (1977), while replicating the finding that fantasy play increased following intervention purported also to demonstrate improvements in intellectual functioning. Unfortunately, they are conspicuously weak in outlining their theoretical formulation which support this latter finding. Statements such as "... psychologists like Piaget and Vygotsky have suggested that imitation and 'pretend' play are basic to aspects of cognitive development ..." (page 367) offer no insight into possible mediating processes; and the remark that "... data indicate a correlation between the degree to which children engage in imaginative play and the cognitive abilities of these children" (page 367) is not supported by any reference to the literature, and is at variance with Smilansky's conclusions (1968). Gotts (1973) cites a variety of studies which suggest that any form of adult intervention will have an ameliorating effect on IQ, and the work of Rosenthal and Jacobson (1968) strongly indicates that teacher expectations have a major role to play in children's achievements. The superiority of the fantasy play programme in the study of Saltz et al. (1977) is plausibly explained as being due to the "Rosenthal" effect, since there is no indication that the teachers were unaware of the experimental hypotheses. Alternatively, it may be argued that the fantasy play programme lends itself to a wider use of both materials and language than the alternative forms of intervention, and was thus more stimulating for the children involved. Whilst

we appreciate that it may be difficult to control such variables, Saltz et al. (1977) lack the basic tools for further explanation in the absence of a theoretical basis.

The results of this study support Smilansky's conclusion (1968). In view of the inadequacy of explanation offered by Saltz et al (1977) to support the notion that cognitive ability is positively related to fantasy play, the statement that fantasy play has a particular role in cognitive development can be refuted.

The arguments which relate fantasy play to social extraversion have been only tentative. The present findings suggest that teachers recognise forms of sociability other than those manifest during fantasy play, and thus sociability towards other children need not take the form of joining them in make-believe play. Fantasy play therefore seems unlikely to be a crucial vehicle for the formation of social relationships.

The failure to find social class differences may appear surprising in view of previous findings. It was noted, however, that Eifermann (1971) showed Smilansky's (1968) findings of less play in working-class immigrant children to be due to a temporal lag rather than a deficit; Rosen's (1974) study was concerned with disadvantaged children for whose behaviour, it may be argued, other factors than social class were more salient. The most recent study to show that "middle-class children spent more time in fantasy play" (Smith and Dodsworth, 1978) only observed children for three periods of five minutes each, which seems an inadequate sample upon which to base such a conclusion. Nevertheless, the very thorough study of Tizard et al. (1976) observed children in great detail for a total sample of 100 minutes per child, and it was fully expected to replicate these results. The samples may

have differed, however, in one important way, that is, that a predominance of the middle-class sample in the present study was drawn from playgroups (14 out of 23) whereas the working-class sample was drawn almost entirely from nursery schools. It is known that the nature of the pre-school centre does affect the frequency of fantasy play (Tizard et al. 1976). It is interesting to note therefore that the playgroup environment apparently enhances fantasy play less than the nursery school one - that is, that it has the effect of damping class differences when middle-class children from a playgroup are compared with working-class children from nursery schools.

The findings of this study leave wide open the question of why children engage in fantasy play. If fantasy play does not subserve cognitive or social functions it is not clear why children should show a particular disposition towards this mode of activity. Hutt (1979b) has argued that ludic activity may be construed as one class of arousal modulating behaviours, and Hutt and Hutt (1978) have afforded some evidence to show that when an organism is operating in the ludic mode the consequences for the CNS are recuperative and consolidatory rather than assimilatory. Viewed in this context individual differences in fantasy play may be more a matter of basal arousal levels and predisposition to fluctuations therefrom than a matter of special aptitudes.

Both Lieberman (1977) and Sherrod and Singer (1977) have tentatively implicated the role of arousal in fantasy play. Hutt's more explicit taxonomy and conceptual formulation, which is supported by some physiological data lends support to such a mechanism. The finding that in nursery schools children engage in more fantasy play than playgroups may be indicative of the relative cognitive demands of these two environments and the consequent effects on arousal.

Fantasy play, however, clearly does involve cognitive mechanisms insofar as it is characterised by symbolic representation and thematic abstraction, and if in fact it does facilitate the reorganisation and consolidation of assimilated information the behavioural effects may be more readily reflected in the complexity of such play rather than its amount. Thus, while the motivation to play may be determined by arousal levels, the quality of the play may be just one reflection of cognitive competence.

Study 8 - Long term correlates of early symbolic play

Singer has been the strongest proponent of the view that symbolic play in early childhood enhances creative intelligence and social responsivity; furthermore, he claims that children who know how to engage in symbolic play are less likely to be impatient and frustrated in stressful situations (Singer, 1961, 1966, 1973, 1976; Singer and Singer, 1976; Sherrod and Singer, 1977). He argues that play and fantasy are inseparable in early childhood, but that they become differentiated during development: the ability to derive pleasure from self generated fantasy in late childhood and adulthood is a developmental consequence of early fantasy play, and is both creative and relaxing. This formulation is also to be found in a statement by Klinger : "... play resembles fantasy at corresponding points in development play may contribute to the solution of instrumental problems, problems of emotional integration, and problems of experiential continuity." (p.277), and he claims that the psychological processes of fantasy and play are "highly related and for at least some limited purposes the one may stand as an analogue for the other." (p.277).

It is worthwhile to reformulate these kinds of statements in terms of an arousal theory of play. Stressful situations are certainly associated with increases in arousal (for example, long-term sensory deprivation (Zubek, 1969)); it could therefore be argued that a child who has become accustomed to modulating his arousal levels through overt symbolic play will subsequently develop the ability to modulate arousal levels through covert thought processes analogous to play (i.e. 'fantasy' in Klinger's (1969) terms, or 'day-dreaming' in Singer's (1966) terms). Such an individual would be expected to show both lower psychophysiological responses to stress, and to have personality traits which reflect the ability to deal effectively with stressful situations.

This study is an attempt to test the predictions:

- (a) that there is continuity in development of symbolic play and day-dreaming;
- (b) that there is a relationship between early symbolic play and cognitive abilities in early childhood; and
- (c) that personality type and psychophysiological responses to stress are related to levels of symbolic play in early childhood.

Because of time constraints on the duration of the research, subjects (and their parents) were asked to provide retrospective reports of play in early childhood by filling in a 'playfulness' questionnaire based on work by Lieberman (1977) (Appendix D). These subjects were solicited through an article in the local evening press which is widely read within North Staffordshire: all respondents to the article were sent questionnaires. Subsequently, subjects for the experimental study were selected by attempting to match two groups for age and sex who reported either extremely high levels or extremely low levels of symbolic

play during the pre-school years.

METHOD

Subjects were 20 (10 male, 10 female) children aged 8 years 5 months to 13 years 2 months. The higher socio-economic classes were over-represented (75%), but were equally distributed between the groups. Subjects were allocated to two experimental groups - high fantasy (HF) and low fantasy (LF) - on the basis of their scores on the playfulness questionnaire and interview material.

Tests and measures

1. Playfulness (for full questionnaire, see Appendix D). This was a thirteen-item questionnaire which contained six 'distractor' questions (items, 1, 2, 3, 8, 10, 11). These items were included to distract the attention of parents from an emphasis on symbolic play and did not form any part of the subsequent analysis. Parents of subjects allocated to the HF groups gave replies to the effect that the children had engaged "very often" in spontaneous make-believe play and showed a "very high" or "high" degree of imagination; their replies to items 6 and 7 (concerning favourite games) included reference to fantasy themes. Subjects in the LF group were reported as engaging "very rarely" or "rarely" in make-believe play and showed a "moderate" to "very low" degree of imagination; their favourite pastimes were typically sedentary activities such as jig-saws/formboards, construction tasks (Lego, etc.) or painting.
2. Intellectual ability All subjects were tested using the WISC.
3. Creativity was measured using the Torrance Tests of Creative Thinking.

Each subject completed the 'A' forms of the tests: "Thinking Creatively with Pictures", and "Thinking Creatively with Words". Both tests

provide measures of Fluency, Flexibility and Originality, and the "Pictures" test provides a further measure of Elaboration (Torrance, 1974). Torrance (1974) reports very low but significant ($p < .05$) correlations between IQ and Verbal Flexibility and IQ and Verbal Originality (0.22 and 0.25, respectively) but the other measures are unrelated to IQ scores. Raw scores on all measures were used for analysis.

4. Personality was measured using New Junior Maudsley Personal Inventory (JMPI), which is a 62 item questionnaire. It is designed to measure the personality factors of Extraversion-Introversion and Neuroticism-Stability; a lie scale (L) is incorporated to enable the detection of faking. L scores tend to be higher for children than for adults on the corresponding Adult EPI, and a high L score does not invalidate the other scales (Furneaux & Gibson, 1966).

5. Psychophysiological measures. Heart-rate was monitored using a Grass Polygraph. Input was from three electrodes strapped to the child's wrist and left and right legs (position III) yielding an ECG and tachograph output (see Figure 7.2). Heart-rate was recorded on an FM tape recorder, and data were subsequently analysed (through an analogue to digital converter) using a PDP-11/05 (programmes were written by University technical staff). For each subject baseline HR and HRV was calculated during a 2-minute pre-task period (after the subject had become accustomed to the apparatus); this period was followed by task instructions and a warming-up task (for details, see Procedure) during which data were not recorded. Subsequently HR and HRV during the task itself and for 1 minute post-task, were recorded and analysed. The analysis programme was designed to ignore artefact, and eliminated two R-wave signals either side of a recorded

artefact; the subsequent record was treated as continuous. HRV and HR measures were corrected to the nearest whole number.

Procedure. Inquiries which resulted from response to the newspaper article were followed up by sending the 'Playfulness' questionnaire. If these were returned, their answers were checked for suitability for inclusion in the study. Those children selected as subjects were then visited at home. At this stage, some subjects declined to continue further in the study because they disliked the idea of the testing and experimentation which was involved. Subjects filled in the JMPI during the home visit, and answered questions about current hobbies and pre-dilection for day-dreaming.

This initial contact was followed up by three visits of each subject to the University. On the first occasion, the full-scale WISC was administered; on the second occasion, the subject completed the Torrance Creative Thinking Tests and was shown the polygraphic equipment; on the third occasion, subjects were 'wired-up' to the polygraph and HR was monitored while subjects were required to perform mental arithmetic. The level of mental arithmetic problems began at a level which was consistent with each child's performance on the WISC, but after ten questions of this type subjects were then presented with problems just beyond their capacity in an attempt to create a moderately stressful situation. HR and HRV were measured 'pre-task', 'during task', and 'post-task'; and the change in HRV from task to post-task was calculated.

RESULTS

An attempt was made to estimate the continuity between symbolic play and day-dreaming by asking parent(s) and child to agree on the

time which the child spent 'day-dreaming' relative to his/her peers. A rank correlation co-efficient was then calculated between this measure (scored in an identical fasion to the symbolic play measure on the questionnaire) and the measure of early childhood symbolic play. This yielded a correlation co-efficient of .521, $p(2\text{-tailed}) < .05$, thus confirming the predicted relationship.

A total of 12 standardised test scores was recorded for each of the ten subjects within the HF and LF groups: there was no statistically significant difference between the groups on a single one of these measures. The sample, as a whole, appears to be fairly representative of the age group population (by JMPI and Torrance scores), if of somewhat above average intelligence.

Cognitive abilities. Table 8.2 show the mean scores and standard deviations for the cognitive tests, and associated t -values (independent groups). Since so many variables were being compared within the same sample, p (2-tailed) levels of $< .005$ were sought; that is, t needed to exceed 2.9. The calculated t values did not even approach this level.

Table 8.2 Scores of HF and LF groups on cognitive tests

Test score	Experimental group		t (df=18)
	HF	LF	
Verbal IQ	118.9 \pm 10.3	112.7 \pm 13.8	1.14
Spatial IQ	114 \pm 16.8	105.4 \pm 9.8	1.39
Verbal fluency	60.2 \pm 28.4	56 \pm 25.3	0.35
Verbal flexibility	26.4 \pm 14.3	31.2 \pm 8.6	0.91
Verbal originality	25.6 \pm 9.6	30.6 \pm 13.9	0.94
Figural fluency	23 \pm 8.9	21.9 \pm 4.5	0.34
Figural flexibility	16.8 \pm 6.4	13.7 \pm 4.2	1.27
Figural originality	13.7 \pm 4.2	23.9 \pm 7.9	0.87
Figural elaboration	50.9 \pm 19.6	53 \pm 16	0.26

Personality. Scores on the JMPI are shown in Table 7.3. Both sets of scores are within the normal range (Furneaux and Gibson, 1966); there is no difference between LF and HF groups.

Table 8.3 Scores of HF and LF groups on JMPI

JMPI sub-scales	Experimental group		t (df=18)
	HF	LF	
Extraversion-Introversion	11.1 ± 2.4	11.3 ± 2.9	0.17
Neuroticism-Stability	8 ± 3.7	10.2 ± 2.7	1.52
Lie scale	10.2 ± 4.8	9.9 ± 4	0.1

Psychophysiological measures. HR and HRV scores were analysed using a 2-way ANOVA (experimental group (2) x condition (3) repeated measures). Changes in mean HR between conditions were statistically non-significant, and there was no difference between the HF and LF groups; HRV was significantly lowered during mental arithmetic task, but the difference between pre- and post-task conditions was significant and there was no difference between LF and HF groups (ANOVA tables and Newman-Keul's comparisons are shown in Tables 8.4 and 8.5). Mean HR and HRV scores are illustrated in Figure 8.3 and Table 8.6.

Table 8.4 ANOVA for mean HR

Source	SOS	df	MS	F
<u>Between groups</u>				
E (HF or LF)	.063	1	.063	.001, n.s.
s's within groups	1768.25	18	98.24	
<u>Within groups</u>				
T (Task condition)	63.75	2	31.87	1.34, n.s.
E x T	11.31	2	5.66	.24, n.s.
T x S's within groups	858.25	36	23.84	

Relationships between measures. Since there was no difference between the groups on any of the standardised test scores, the data were collapsed into single sets of scores on each variable to consider possible inter-relationships. Product-moment correlations were calculated between the test scores (see Table 8.7). These data reveal^a significant correlations between verbal IQ scores and a number of the creative thinking scores, which is at variance with Torrance's original finding (Torrance, 1974); they also show some significant inter-relationships within the Torrance test scores, which is consistent with the normative data in the manual.

The most surprising feature of these results is the strong negative correlation between N scores and change in HRV (dHRV) between the 'task and 'post task' conditions. This measure of change in HRV (mean = 9.1, sd = 6.1) was calculated as an indicator of the reduction in arousal following the task. It was originally hypothesised that the HF group would have a higher change score, reflecting a faster resumption of baseline arousal levels; this

Table 8.5 ANOVA for HRV

Between groups

E (HF or LF)	58.02	1	58.02	0.3, n.s.
S's within groups	3552.83	18	197.38	

Within groups

T (Task condition)	2049.72	2	1024.87	59.06, p<.01
E x T	56.92	2	28.47	1.64, n.s.
T x S's within groups	624.67	36		

Newman-Keul's post hoc comparisons:

q (Pre-task - task)	= 5.01 p<.01
q (Post-task - task)	= 3.32 p<.05
q (Pre-task - post-task)	= 1.76 n.s.

hypothesis was not borne out (\bar{X} (HF) = 10.9 ± 6.3 , \bar{X} (LF) = 7.3 ± 5.6 , $t(18df) = 1.3$, n.s.). The significant negative correlation between N and dHRV suggests that children with a tendency to be anxious have an arousal system which is less easily restored to equilibrium, than their more stable peers. This factor is not, however related to early symbolic play.

DISCUSSION

The predicted continuity between early symbolic play and predilection for day-dreaming was borne out by this study, despite the relative crudity of the measures involved. However, none of the other experimental hypotheses was supported. It proved impossible to distinguish between HF and LF groups on measures of cognitive ability; there were no personality differences between the two

groups; and there were no differences in the psychophysiological measures that were employed. These results then support the general conclusion from Studies 5, 6 and 7 that symbolic play does not have any unique role in development.

It cannot, however, be denied that symbolic play does provide a vehicle for the practise of certain cognitive (notably verbal-type) skills, and these results do not provide any grounds for regarding symbolic play as a frivolous activity. Nonetheless, it has not been possible to evaluate the functional consequences of symbolic play in terms of either short- or long-term intellectual or personality advantage. It has already been argued that the motivational substrates of play are mediated by arousal mechanisms, although it was hypothesised that the functional consequences of different types of play might be best formulated within a cognitive developmental framework. The present negative results indicate that it might be more worthwhile to explore the functional relationship of play to other activities in terms simply of psychophysiological consequences.

The finding, in the present study, of a negative correlation between the Neuroticism-Stability Scale of the JMPI and the return of heart-rate-variability to baseline levels after a stressful task, offers some support to arousal models of anxiety (e.g. Gray, 1976). The highly anxious subject appears to have an arousal system which is relatively difficult to damp once the stressful circumstances have been withdrawn. Thus, any behavioural response which facilitates the modulation of arousal should be regarded as adaptive, in that it would optimize subsequent responses. That is, an organism in a state of high arousal will tend to reject new information input (the

autist, par excellence), whereas the moderately aroused organism will make appropriate (and adaptive) responses.

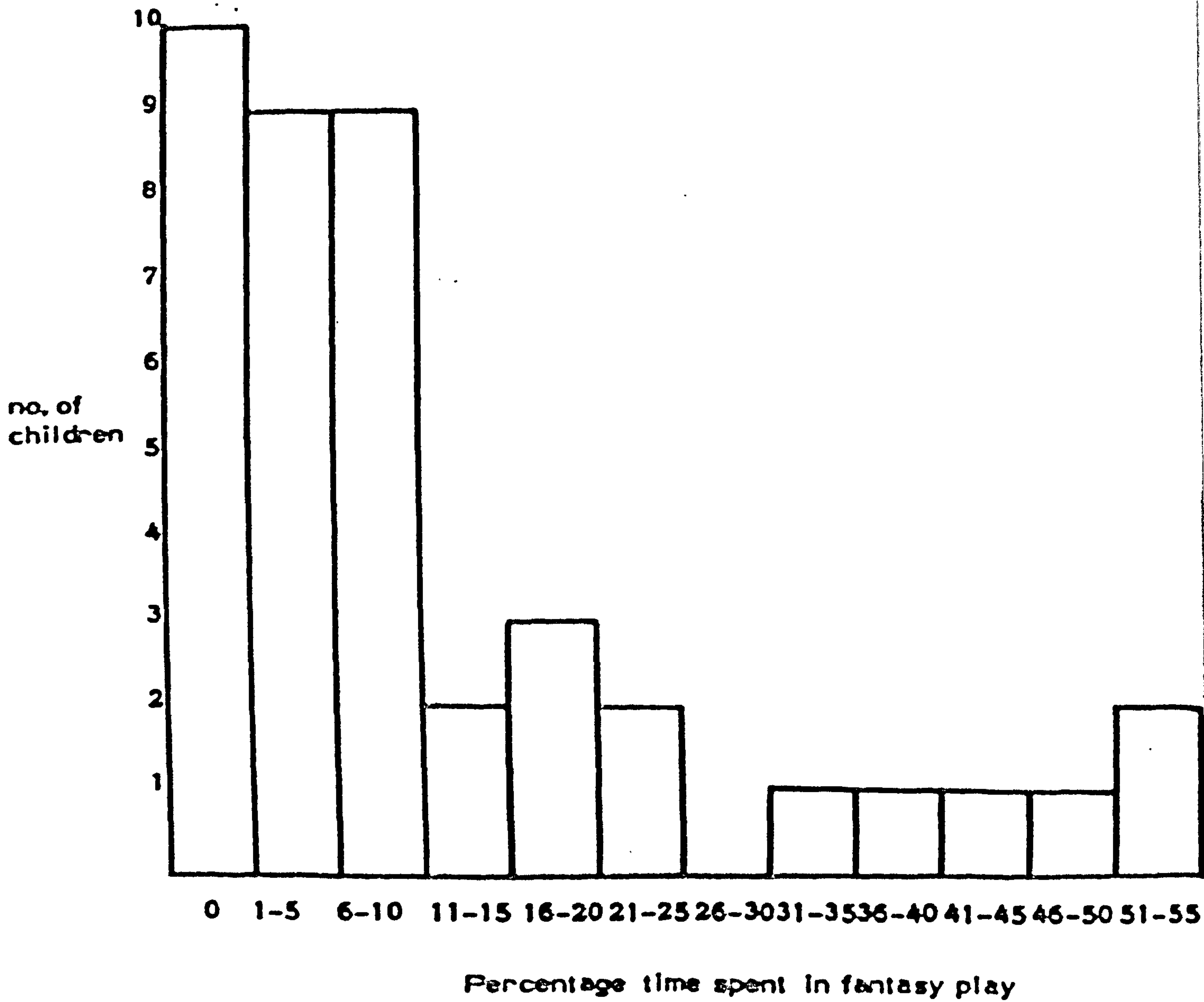
Children who engage in particular forms of play may be doing no more than maintaining arousal at optimal levels. Symbolic play and manipulative play can both serve this function, but otherwise appear to be fairly inconsequential. The next chapter, therefore, considers the psychophysiological parameters associated with play and its developmental analogue, day-dreaming; and the final chapter will attempt to interpret these data in terms of the biological adaptiveness of play behaviour.

Table 8.7 Inter-correlations between test measures

	1	2	3	4	5	6	7	8	9	10	11	12	13
WISC	-												
Verbal IQ	1												
Spatial IQ	2	-											
Creative Thinking	3	.7	.24										
Fluency	4	.38	.15	-									
Flexibility	5	.67*	.15	.54	-								
Originality	6	.67*	.43	.45	.45	-							
Fluency	7	.59*	.56*	.21	.19	.69*	-						
Flexibility	8	.55*	.31	.29	.3	.56*	.45	-					
Originality	9	.24	.51	.33	.32	.39	.43	.35	-				
Elaboration	10	-.15	-.07	-.08	-.25	-.2	-.03	-.12	-.16	-			
Extraversion	11	.08	-.66*	.04	.27	-.03	-.41	-.13	-.51	-.04	-		
Neuroticism	12	.16	.45	.33	.2	.57	.49	.39	.28	-.24	-.44	-	
Lie scale	13	-.1	.42	-.2	-.32	.04	.36	-.34	.23	.13	-.63*	.13	-
Arousal	dHRV												

* p < .01

Figure 8.1. To show percentage time spent in fantasy play (Study 7)



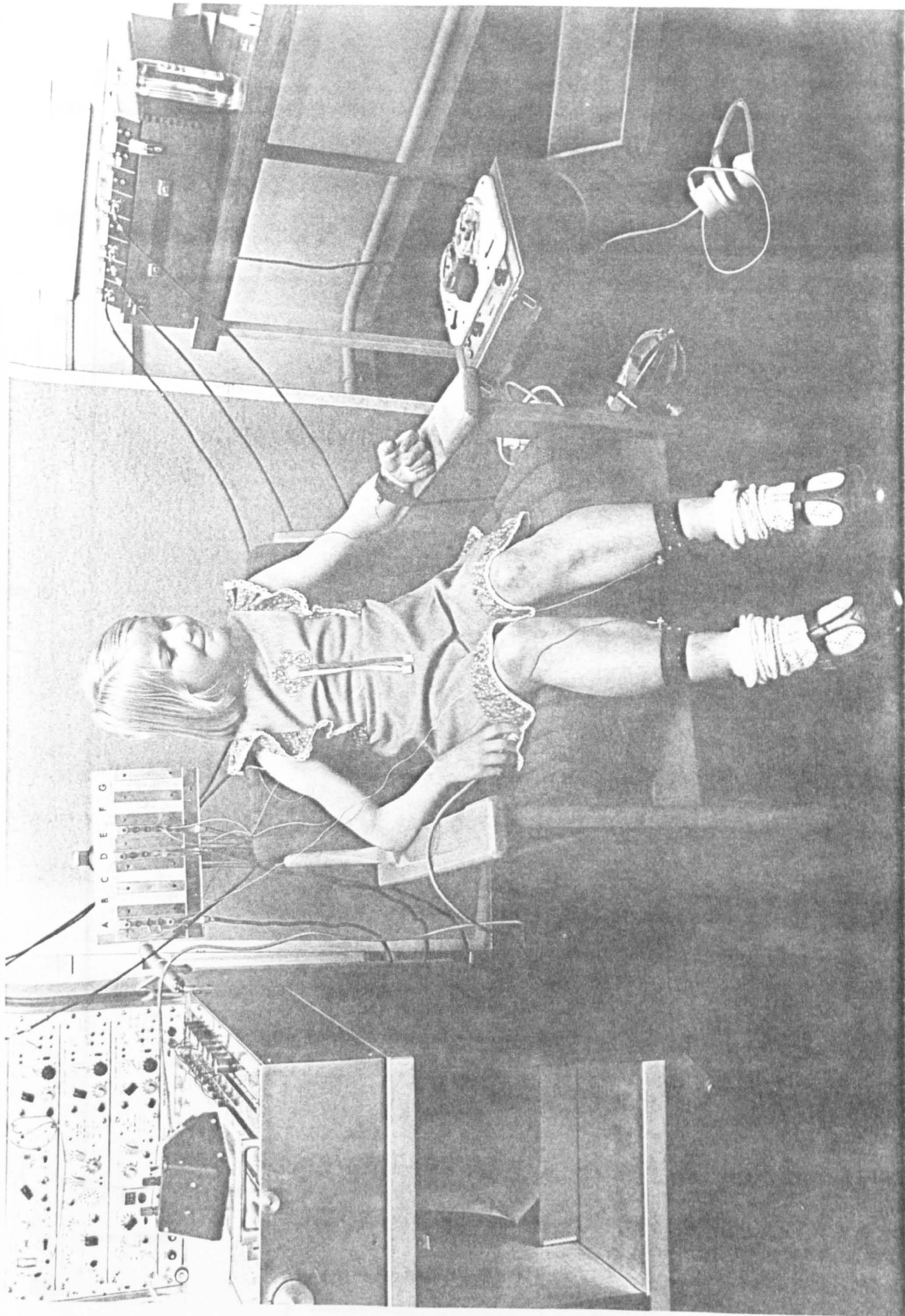
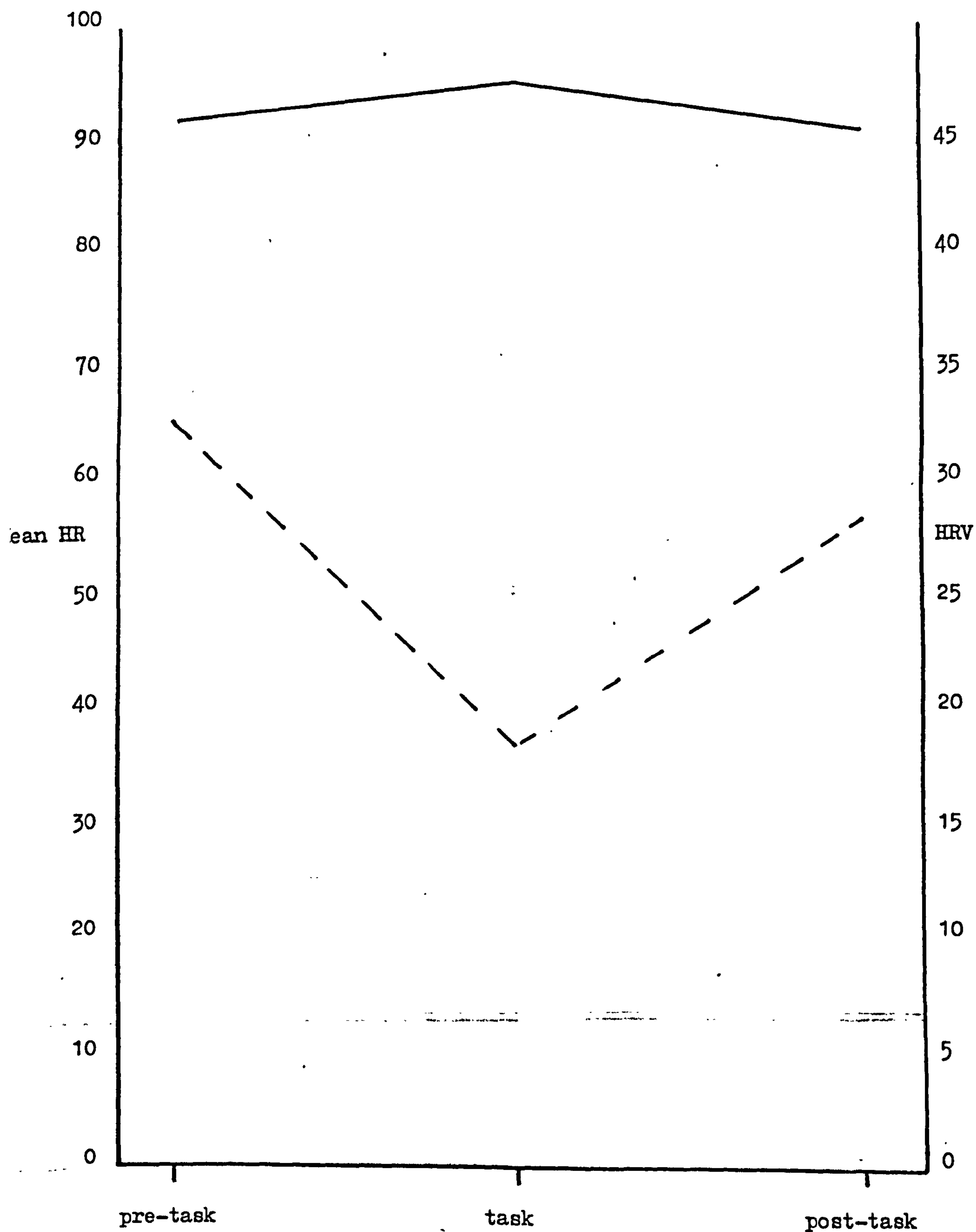


Figure 8.2 To illustrate heart-rate monitoring using the polygraph

Figure 8.3 Mean HR and HRV scores during pre-task, task, and post-task

Key

--- HRV

— Mean HR

Table 8.6 Values of HR and HRV

	Pre-task	Task	Post-task
HR	93 ± 7.7	94.6 ± 6.8	92 ± 5.5
HRV	32.9 ± 9.3	18.9 ± 7.6	28 ± 9.2

CHAPTER 9

PHYSIOLOGICAL CORRELATES OF CHILDREN'S PLAY

The validity of a taxonomic division of manipulative play into 'epistemic' and 'ludic' categories is supported strongly by Studies 1-4; the distinction has been made both on the basis of morphological differences in these two types of behaviour (Studies 1 and 2) and their differences in function (Studies 3 and 4). It was suggested that the constrained behavioural sequences which typify exploration may be adaptive responses to increases in psychophysiological arousal, whereas the more relaxed 'ludic' behaviours are reflections of lower arousal.

In Chapter 2, it was argued that the suppression of heart-rate-variability (HRV) and an increase in low-voltage fast-wave (14-20Hz) EEG activity can be used as indicators of an increase in arousal in human subjects. It may, therefore, be predicted that these physiological correlates would distinguish periods of exploratory and ludic behaviour. Study 9 reports an investigation of that hypothesis.

Study 9 - Heart-rate-variability and EEG during exploratory and ludic behaviour

Studies 1 and 2 described an experiment based on work by Hutt (1966), and using this experimental paradigm it was possible to isolate periods of exploratory and ludic behaviour. The theoretical position outlined by Berlyne (1960) and by Hutt (1966, 1970) would predict that during the exploratory session of this experiment (in which a novel toy is first introduced to the child) HRV would be suppressed and there would be faster

EEG activity relative to session six (during which ludic activity predominates). This study describes an attempt to monitor these psychophysiological variables within the experimental design described in Studies 1 and 2.

Until recently, the impedimenta of polygraphic recording techniques have precluded the monitoring of EEG and HR during free-field behaviour. However, it was decided that an attempt could fruitfully be made to develop a method of monitoring these variables using a telemetry system of the type outlined by Lee, Hutt, Forrest and Hutt (1965). Unfortunately, in a number of pilot trials it was found that EEG pad electrodes (fixed either with a helmet or a head-band) were unsatisfactory: they tended to slip, and were subject to excessive artefact. Ultimately, conventional silver-silver chloride electrodes proved to be the most satisfactory type for telemetry recording, although these have the grave disadvantage of being fiddly to attach and they are not especially comfortable for the child who has to wear them. It was intended that six children would take part in an identical experiment to that described in Studies 1 and 2, but that they would do so whilst small EEG and HR telemetry recording devices enabled the monitoring of arousal levels. In the event, technical difficulties made this impossible: sometimes the children positively refused to have the devices attached; on other occasions, when the devices were attached it was impossible to eliminate artefact without disrupting the experiment. After a multitude of attempts, a reasonable recording was obtained for only one child; on this occasion, the tape-recorder was the only item of equipment which failed, and an analysis of the record could be made only by eye. These,

admittedly limited, data are reported below.

METHOD

The subject was a 4 year old boy, well known to the experimenter, and familiar with the playroom where the experiment took place.

Procedure. This was identical to Studies 1 and 2, except that during the introductory sessions, the child was shown the telemetry system, the purpose of which briefly explained and demonstrated to him. The telemetry equipment was fitted only on one introductory session, and on sessions one (exploration) and six (play).

Silver-silver chloride electrodes were attached to the scalp at positions O_1 and P_z (i.e. over the left occipital lobe), and the EEG was recorded across these positions. Collodion adhesive was used to stick the electrodes, and neptic jelly was injected into the electrodes (after they had been attached) to reduce inter-electrode resistance to less than 5Kohms. The electrode leads were wired into a small transmitter which rested on the child's collar. A similar device was used to record heart-rate, but Devices stick-on electrodes were used which were attached to the child's chest. The signals were received on an FM tuner and were recorded via a standard Grass Polygraph together with a time signal. A video-cassette recording was also made of each session.

RESULTS

For each minute (excluding the first and last) that the child spent in the caravan, one 10 sec artefact-free period of recording was used for analysis. Each of these periods was

matched to the video-recording to ensure that the physiological record accurately represented periods of exploration and play. A second observer (CH) confirmed the validity of the behavioural record. Samples of these data are shown in Figures 9.1 and 9.2.

The integrator facility on the polygraph provides a measure of total power of the EEG: thus, low voltage, fast wave activity has lower power than higher voltage, slow wave activity. An increase in arousal is therefore reflected as a decrease in the power score. EEG was integrated automatically over 10 sec time samples. Table 9.1 and Figure 9.3 show that total power remained more or less constant during play, but increased during the final few minutes of exploration, (i.e. as the child familiarised himself with the novel toy, arousal decreased). The mean power scores during exploration and play were

$$\bar{X}_{(\text{exp})} = 0.83 (\pm .096) \quad \text{vs, and} \quad \bar{X}_{(\text{play})} = 1.39 (\pm .083) \quad \text{vs.}$$

Using a correlated t-test (2-tailed) these values are found to be significantly different ($t = 17.4$ d.f. = 7, $p < .01$), and reflect a lower level of arousal during play.

Heart-rate-variability during exploration was 15.4, during play it was 67.9 (see Table 9.1 and Figure 9.4). These are high figures and it is possible that this child is not representative of his age group in this respect; however, there is no reason to suspect that the pattern of change is not a valid one. Correlated t-tests (2-tailed) showed that both mean HR and HRV were significantly different during exploration and play: during exploration HR was high ($\bar{X}_{\text{exp}} = 90.2$) and HRV was suppressed; during play HR decreased ($\bar{X}_{\text{play}} = 76.6$) and HRV increased

(HRV: $t = 8.6$, d.f. = 7, $p < .01$; mean HR: $t = 6.4$, d.f. = 7, $p < .01$). Lacey and Lacey (1970) argue that an increase in arousal associated with information processing is reflected by an increase in mean HR, therefore the measures of both mean HR and HRV confirm the expected relationship between arousal and/exploration and play/.

DISCUSSION

The limitations of these data are self evident. Nonetheless, they do provide some tentative support for arousal theorists in the field of exploration and play. Certainly, for this child, arousal levels, measured as a function of HRV and EEG, are lower during play than exploration. Furthermore, arousal could be seen to be decreasing during the exploratory session although it remained fairly constant during play.

The practical difficulties of working with 4-5 year old children made it impossible to collect more evidence to evaluate arousal theories with this age group; Studies 10 and 11, therefore, use subjects from a different age group.

Study 10 - Exploration, play and problem-solving in young children

It is often difficult to distinguish exploratory from problem-solving responses in the young child. Problem-solving responses are generally constrained by the nature of the problem which has a specific end-point or solution. Exploratory responses are less so constrained but initially at least, consist of a set of species-specific patterns (Chapters 3 and 4). However, on behavioural grounds alone it may not be possible to show any distinction between these two activities. Moreover, both these activities have the function of reducing information conflict and therefore would appear to have more in common with each other than either of them would have with play.

The first study sought to examine whether a psychophysiological measure would reflect, and thereby help illuminate, the behavioural differences (or lack of them) between these behaviours. Heart-rate was used as the psychophysiological measure (to maintain consistency between this, and the earlier reported studies 8 and 9; and for reasons outlined earlier).

METHOD

Subjects were 14 children ranging in age from 1 year 11 months to 2 years 4 months and were selected from a larger group of 24 children. Ten subjects were eliminated because their ECGs did not remain artefact-free for an adequate period of time. These subjects were behaviourally similar to the other 14 except that much of the ECG was unusable for reasons of movement, crying etc. The children had already been studied at 6 months and 12 months of age and the mothers knew that the children's responses and HR were being recorded while they played with different types of toys.

Apparatus. Heart-rate was recorded via a telemetry link: stick-on electrodes were attached to the child's chest and the transmitter was pinned to its clothing (for further details see Hutt et al. (1975)). The child's behaviour was recorded by one video-camera and the ECG and tachograph write-out by another, the two pictures then being superimposed to yield a composite behavioural and HR record (Figure 9.5).

Three brightly coloured and commercially available toys were used for play: a squeaky giraffe, a fire-truck with three wooden slot-in men, and a spin-wheel bird cage. A 'new' toy consisted of a modified version of Galt's 'pop-up' toy: the case which contained the four 'pop-up men' was mounted on a

bright red base which also housed the buzzer connected to the spring of one 'man' and a light connected to the spring of another. Pressure on these two 'men' activated buzzer and light respectively. A six-piece formboard in which each piece was a different colour was also used.



Figure 9.5 - To illustrate composite behavioural and HR record.

Procedure. Mothers brought their infants to a play-room in a caravan which served as a mobile laboratory. The electrodes were attached to the child while he sat on his mother's lap in the anteroom. Mother and child then moved into the playroom where the infant was placed on a low chair in front of a low table; the mother sat next to the child. During a period of acclimatisation, usually lasting between 3 and 5 minutes, mother and child looked at cartoon pictures. After this period

the three commercial toys were placed on the table. This was designated the play phase and lasted 3 minutes. The toys were then removed, the 'new' toy substituted for one of them and the three returned to the table. This phase was designated the exploration phase and lasted 3 minutes, after which the toys were taken away. At the beginning of each of these phases and upon presentation of the toys, the experimenter said to the child, "Here are some toys for you to play with". The child was next given the formboard to complete, with the instruction, "See if you can put these pieces into their proper holes"; the duration of this problem phase was 3 minutes.

Analysis. The HR record was monitored during the video playback and behavioural epochs were marked off according to whether they fitted the morphological criteria of specific exploration or play (see Hutt, 1970); activity which was not either was classified 'other' (e.g. talking, pointing, etc.). The problem phase had to be treated somewhat differently since there was a specific objective to be fulfilled. In this phase, therefore, activity concerned with placing the pieces was distinguished from all other activity (e.g. rolling or throwing pieces). Two observers, one of whom was unaware of the different phases of the study, made behavioural classifications (play, exploration, problem-solving or 'other') with a reliability of 0.87. Both observers were 'blind' to the HR data insofar as no information about HR was available at the time of the behavioural analysis.

Three 15-second artefact-free epochs were then selected

from the 'phase-appropriate' behaviours; beat-by-beat HR readings were obtained; mean HR and HRV (variance) were calculated for each epoch and then a mean for HR and HRV derived from these for each phase.

RESULTS

The amounts of 'phase-appropriate' behaviours in the three phases were as follows:- Play 86 seconds (48%); Exploration 105 seconds (58%); Problem 127 seconds (70%). In each phase, that behaviour by which the phase was designated was the predominant one. There was no significant difference in mean HR between the conditions ($F = 0.7$; d.f. = 2,26; n.s.), but there was a significant change in HRV ($F = 10.05$; d.f. 2,26; $p < .01$). Post-hoc tests revealed no significant difference between exploration and problem-solving, but a significant difference between play and the other conditions (Table 9.2). Actual mean values and standard deviations are given in Table 9.3 and are illustrated in Figures 9.6 and 9.7.

Table 9.2 ANOVA table for HRV during play, exploration and problem-solving

Source	SOS	df	MS	F
Between S's	8573.1	13	659.5	
Within S's	4027.1	26	154.9	
Condition	3114.0	2	1557.0	10.05, $p < .01$
Total	15,714.2	41	383.3	

Newman-Keul's post-hoc tests:

- q (Exploration - Problem-solving) = 2.02, n.s.
- q (Exploration - Play) = 4.2 , $p < .01$
- q (Play - Problem-solving) = 6.2 , $p < .01$

Table 9.3 Values of mean HR and HRV during play, exploration and problem-solving

	Exploration	Problem-solving	Play
HR	116.4 ± 8.7	117.3 ± 7.6	118 ± 9
HRV	25.9 ±12.9	19.2 ±11.8	39.8 ± 25.7

HR and HRV did not correlate at all with each other, although there were significant correlations between HR within the three conditions and between HRV within the three conditions. These correlations are given in Table 9.4.

Table 9.4 Correlations between the measures during play, exploration and problem-solving

			1	2	3	4	5	6
Mean HR	Exploration	1	-					
	Problem-solving	2	.9*	-				
	Play	3	.86*	.66*	-			
HRV	Exploration	4	-.17	-.06	-.44	-		
	Problem-solving	5	-.06	.06	-.33	.67*	-	
	Play	6	-.29	-.1	-.63	.64*	.62	-

* p<.01, (2-tailed)

DISCUSSION

It was reassuring to find that, on objective criteria, the predominant behaviour in each phase was in accordance with expectation. The relatively reduced amount of play in the first phase was due to the fact that when the toys were first presented, the children spent a while examining them and showing them to mother.

It may be argued that the observed trend in HRV was due to temporal factors and that the order of the phases should have been counterbalanced amongst the subjects. This particular order was maintained in order to minimise the effects of boredom. However, the effects obtained are contra hypothesis since it would be expected that as the child became more familiar with the situation and hence more relaxed, HRV would increase rather than decrease. The present results suggest that the mental effort involved in play is small, relative to task behaviours.

The fact that even 2-year-old children manifested a suppression of HRV when concentrating upon a puzzle is one of potential practical significance. With very young children, it is often difficult to assess the task-demands of a particular situation upon the child. Since HRV proved to be such a sensitive index of attention, it may be possible to titrate different problems against magnitude of HRV suppression.

Study 11 - Day-dreaming and problem-solving in older children

In later childhood, children who reported high levels of symbolic play in the pre-school years also report high levels of day-dreaming. It has been suggested that day-dreaming is simply an internalised, covert form of play (Groos, 1898; Piaget, 1951; Klinger, 1969; Singer, 1973), and the subjective reports of children in Study 8 suggest that there may be a developmental continuity between these behaviours.

As children begin formal education their opportunities for overt play are reduced. On the other hand, day-dreaming increases throughout later childhood, and has been considered as internalised, covert play which can be indulged in, in circumstances where overt ludic behaviour would be unacceptable. Thus, bouts of day-dreaming in older children should be associated with a similar increase in HRV as play is in younger children, and this study sought to examine that relationship, and to investigate whether the physiological correlates of problem-solving in 2-year-old children (reported in Study 10) are comparable with those of problem-solving in older children.

METHOD

Subjects were 16 children between the ages of 8 and 10 years (mean age 9 years 3 months).

Apparatus. Heart-rate was recorded directly through a Grass Polygraph. Input was from three electrodes strapped to the child's left wrist and left and right legs, yielding an ECG and tachograph write-out (as in Study 8).

For the problem or task, the apparatus was a 6-layered pyramid, each layer consisting of four interlocking blocks. The dowels on these blocks could only be assembled in one way prior to insertion in the holes of their counterparts.

Procedure. All children were acquainted with the experimenter. They were first shown the apparatus and told what it recorded. They were asked whether they knew what 'day-dreaming' was and whether they engaged in it. All answered in the affirmative. The child was then seated at a table and answered a few questions, giving his name, age and class in school. He was then asked to relax while the experimenter checked that the apparatus was functioning - this period of relaxation lasted 3 minutes. He was then asked either to do the pyramid task or to day-dream.

In the task condition, the pyramid was taken apart in front of the child and he was asked to assemble it "as quickly as possible, using only your right hand". In the day-dreaming condition, he was asked to "think about anything you like". Half the children did the task before day-dreaming and the other half day-dreamed before the task.

Analysis. Three 20-beat samples from each ECG were taken at random from each of the 3 conditions: Baseline, Day-dreaming and Task. Mean HR and HRV were calculated for each of these samples and then an overall mean HR and HRV for each condition derived from these.

RESULTS

The mean HR and HRV for each condition are shown in Figures 9.8 and 9.9; actual values are given in Table 9.4. Analysis of variance showed significant changes of both HR and HRV between conditions (Heart-rate: $F = 37.5$, d.f. = 2,30; $p < .01$; heart-rate-variability: $F = 8.9$, d.f. = 2,30; $p < .01$). Post-hoc tests showed that these differences were due to HR changes during the task condition (Tables 9.5 and 9.6).

Table 9.4 - Values of mean HR and HRV during baseline, day-dreaming and task

	Baseline	Day-dreaming	Task
HR	88.9 ± 12	87.8 ± 11.5	96.6 ± 11.2
HRV	32.2 ± 22.7	36.9 ± 27.8	16.6 ± 15.9

Table 9.5 - ANOVA for mean HR during baseline, day-dreaming and task conditions

Source	SOS	df	MS	F
Between S's	5754	15	383.6	
Within S's	291.5	30	9.7	
Condition	729.4	2	364.7	37.5, $p < .01$
Total				

Newman-Keul's post-hoc tests:

q (Baseline - day-dreaming) = 1.5, n.s.
 q (Baseline - Task) = 9.8, $p < .01$
 q (Task - day-dreaming) = 11.3, $p < .01$

Table 9.6 ANOVA for HRV during baseline, day-dreaming and task conditions

Source	SOS	df	MS	F
Between S's	17042	15	1136.13	
Within S's	6095.5	30	203.2	
Condition	3610.4	2	1805.2	8.9, p<.01
Total				

Newman-Keul's post-hoc tests:

q (Baseline - day-dreaming) = 1.4, n.s.
q (Baseline - task) = 4.4, p<.01
q (Task - day-dreaming) = 5.7, p<.01

As in Study 10, HR and HRV did not correlate at all with each other, although there were significant correlations between HR within the three conditions and between HRV within the three conditions. These correlations are given in Table 9.7.

Table 9.7 Correlation matrix between HR and HRV measures in different experimental conditions

		1	2	3	4	5	6
{	Basal HR	1	-				
	Day-dreaming HR	2	.96*	-			
	Task HR	3	.89*	.93*	-		
{	Basal HRV	4	-.19	-.21	-.1	-	
	Day-dreaming HRV	5	-.18	-.34	-.24	.6*	-
	Task HRV	6	-.16	-.37	-.32	.66*	.72*

* p (2-tailed) <.05, (14df)

DISCUSSION

As before, attention to a task was associated with a dramatic suppression of HRV. Indeed, there is a remarkable similarity between the day-dreaming and task HRV in this study and the play and problem HRV of Study 10. This finding provides some tentative evidence to support the theoretical arguments which link the categories of play and day-dreaming on functional grounds.

Further, it is interesting to note, from the correlations between conditions that both mean HR and HRV are consistent within individuals. The lack of correlation between the two measures indicates that changes in HRV over relatively long periods of time are not influenced by the level of mean heart-rate.

The finding that attention to a task is accompanied by suppression of HRV is a consistent one. The tasks demanding attentive observation that were given to their subjects by Porges and Raskin(1969) resulted in a decrease in HRV and an increased respiration frequency. These authors surmised that the latter may have been responsible for the decrease in HRV. Luczak and Laurig (1973) however, have since shown that, in adults, the effect of respiration upon HRV is not a dominant one. Although Sroufe and Morris (1973) demonstrated that in children both respiratory rate and depth could have an effect on HRV - either fast or shallow breathing resulted in a more stable HR - these results are somewhat equivocal in that the control of breathing was presented as a task per se and this exercise itself

may have led to the suppression of HRV. In any case, should a dependence of HRV upon respiration be established, it would not detract from lawful relationships that may be deduced about behavioural states on the one hand and physiological indices on the other.

Lacey and Lacey (1958) and more recently Porges (1972), have suggested that autonomic variability is positively correlated with the length of time an individual can maintain maximal readiness to respond. In a review of the experimental literature on work-load and HRV, Kalsbeek (1973) concluded that HRV is a sensitive indicator of "the proportional occupation of an individual's single channel capacity during rest and work" and Price (1975) observed that, relative to a resting level, sustained attention to sensory inputs was accompanied by reduced HRV. Thus, the consensus of findings may be summarised as follows: a highly labile autonomic system suggests that an individual is optimally receptive to incoming cues or information; filtering and processing such information leads to a suppression of HRV. This formulation is well supported by Porges' (1972) finding that subjects who showed the greatest suppression of HRV performed reaction-time tasks most efficiently.

GENERAL DISCUSSION

The use of HRV certainly did support the distinctions between activities that had been made on behavioural grounds. In Study 9 play and exploration were distinguished from each other; but Study 10 found exploration could not be distinguished from problem-solving, suggesting that these two activities were associated with comparable task-demands. Their

categorisation as epistemic behaviours, whose function is to optimise cue-utilisation, seems amply justified.

The heart-rate results obtained here also enable us to pursue a little further, albeit speculatively, questions about the functions of non-utilitarian behaviours like play and day-dreaming. Play has always been associated with relaxed states of the organism, states when the exigencies of survival are minimal. What then can be the function of play?

During play, information processing is reduced, but by its activities the organism nevertheless keeps its nervous system primed for coping with potential demands on attentive processes. A similar function may also be ascribed to day-dreaming. At a cognitive rather than a neurobiological level, the analogous function of both behavioural activities may be the rehearsal, reorganisation and consolidation of information already assimilated. Perhaps, contrary to the conventional view of educationalists, day-dreaming may be actively useful in preparing a child to give optimal attention to salient information.

TABLE 9.1

PSYCHOPHYSIOLOGICAL MEASURES DURING EXPLORATION AND PLAY

<div>Minutes</div> <div>Physiological measure</div>									mean (\pm s.d.) values
	1	2	3	4	5	6	7	8	
Heart-rate variability	12.6	24.1	9.7	24.4	16.1	11.4	15.1	9.7	15.4 (± 6)
	54.2	104.7	85.4	72.1	62.1	68.9	49.7	46.8	67.9 (± 19)
Mean heart-rate (BPM)	93.8	84.9	97.7	85.1	89.5	93.8	88.1	88.9	90.2 (± 4.5)
	71	73.7	74.7	76	76.5	85.2	75.6	80.2	76.6 (± 4.3)
Power (μ v. secs)	0.7	0.8	0.8	0.8	0.75	0.9	1	0.9	0.83 ($\pm .096$)
	1.3	1.4	1.5	1.4	1.3	1.3	1.5	1.4	1.39 ($\pm .083$)

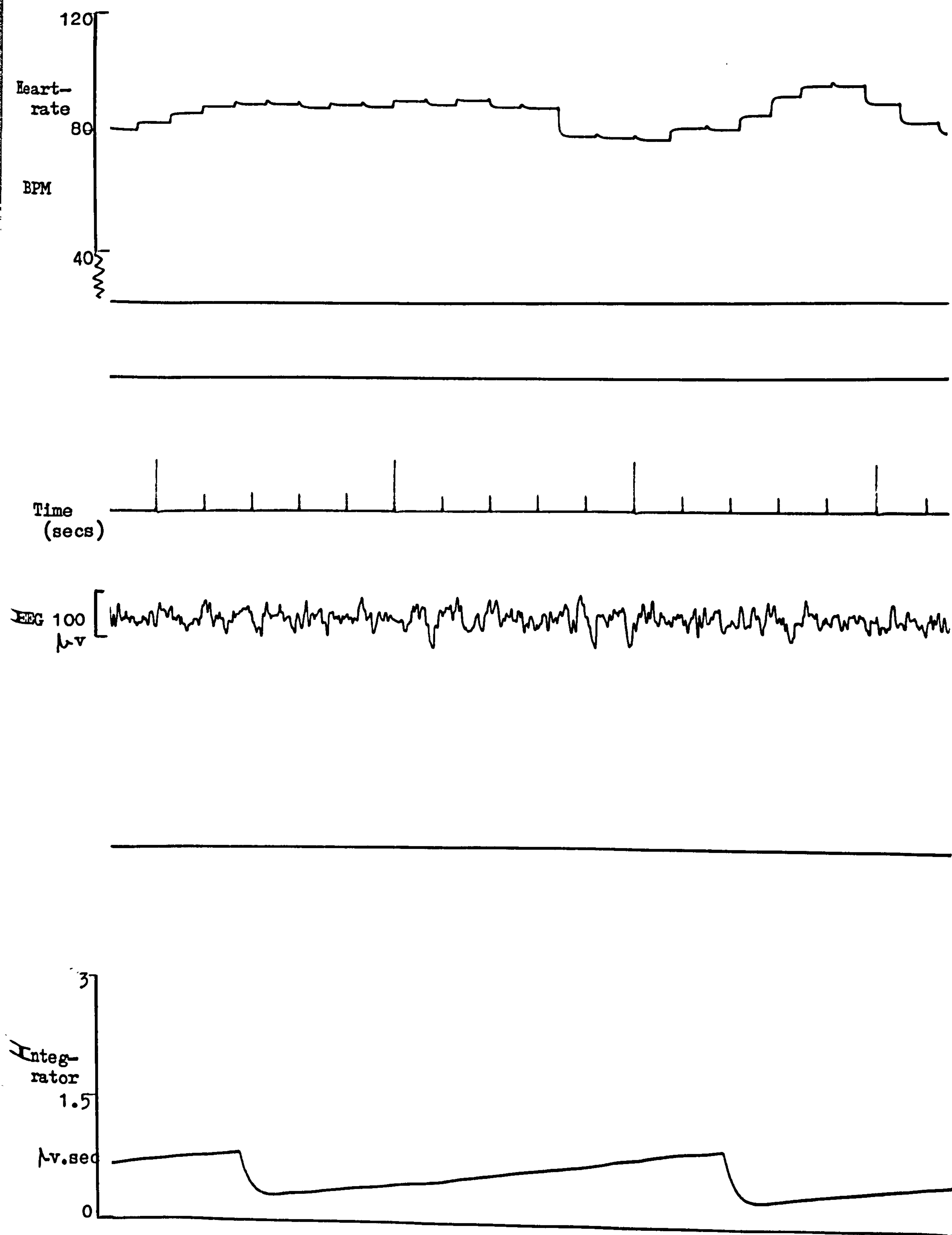
EEG and heart-rate during explorationFigure 9.1.

Figure 9.2

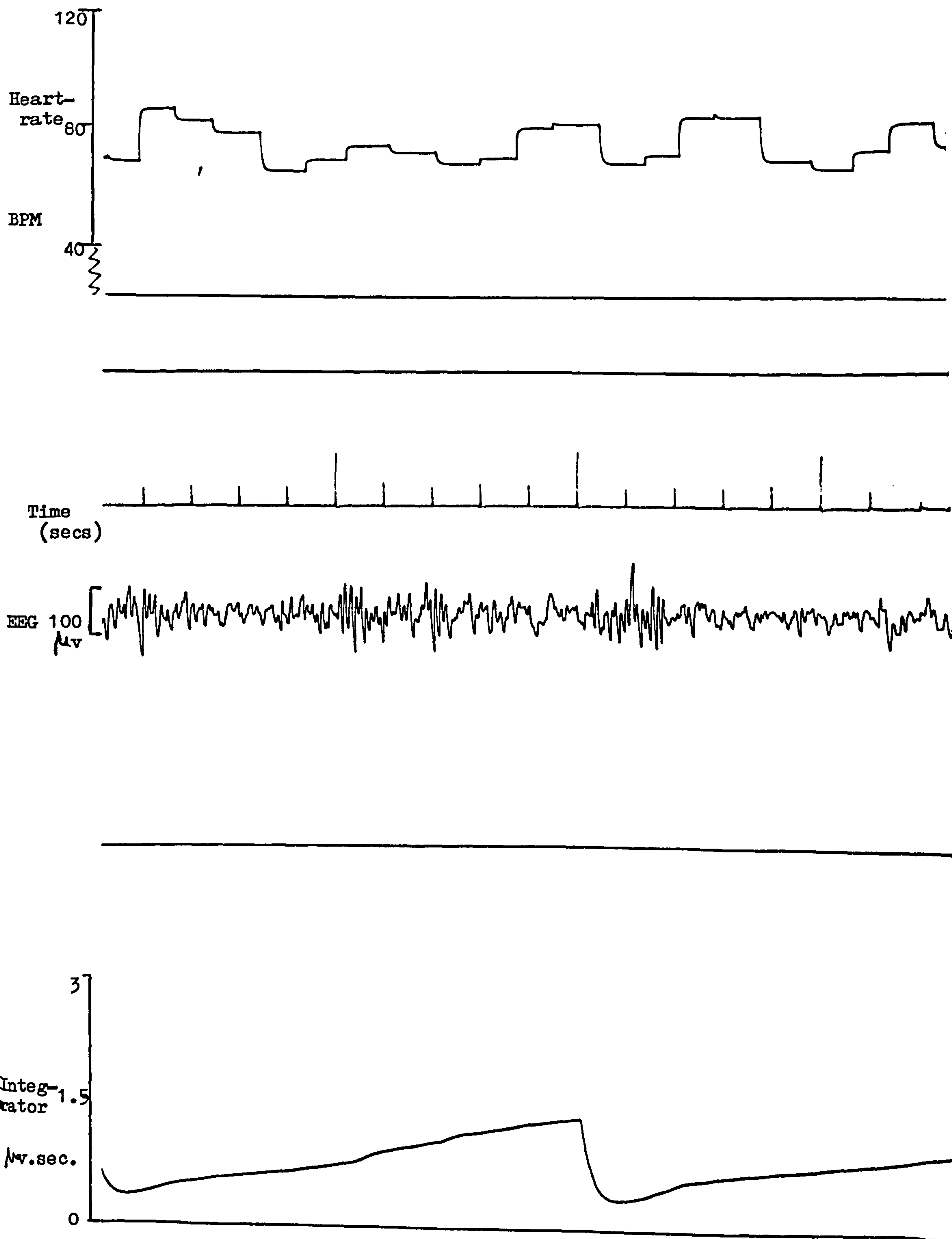
EEG and heart-rate during play

Figure 9.3 Integrated EEG during exploration and play

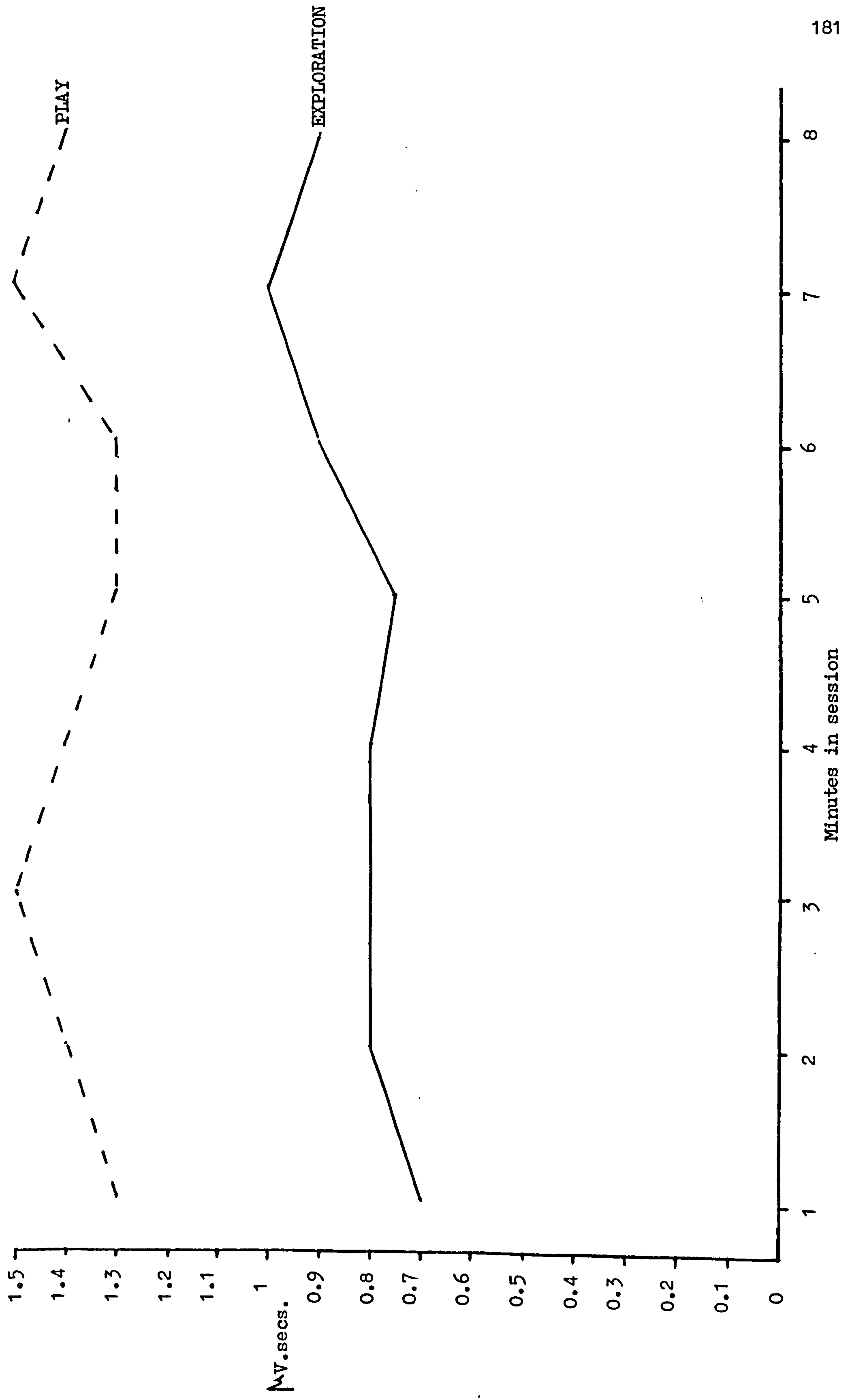


Figure 9.4 Heart-rate variability during exploration and play

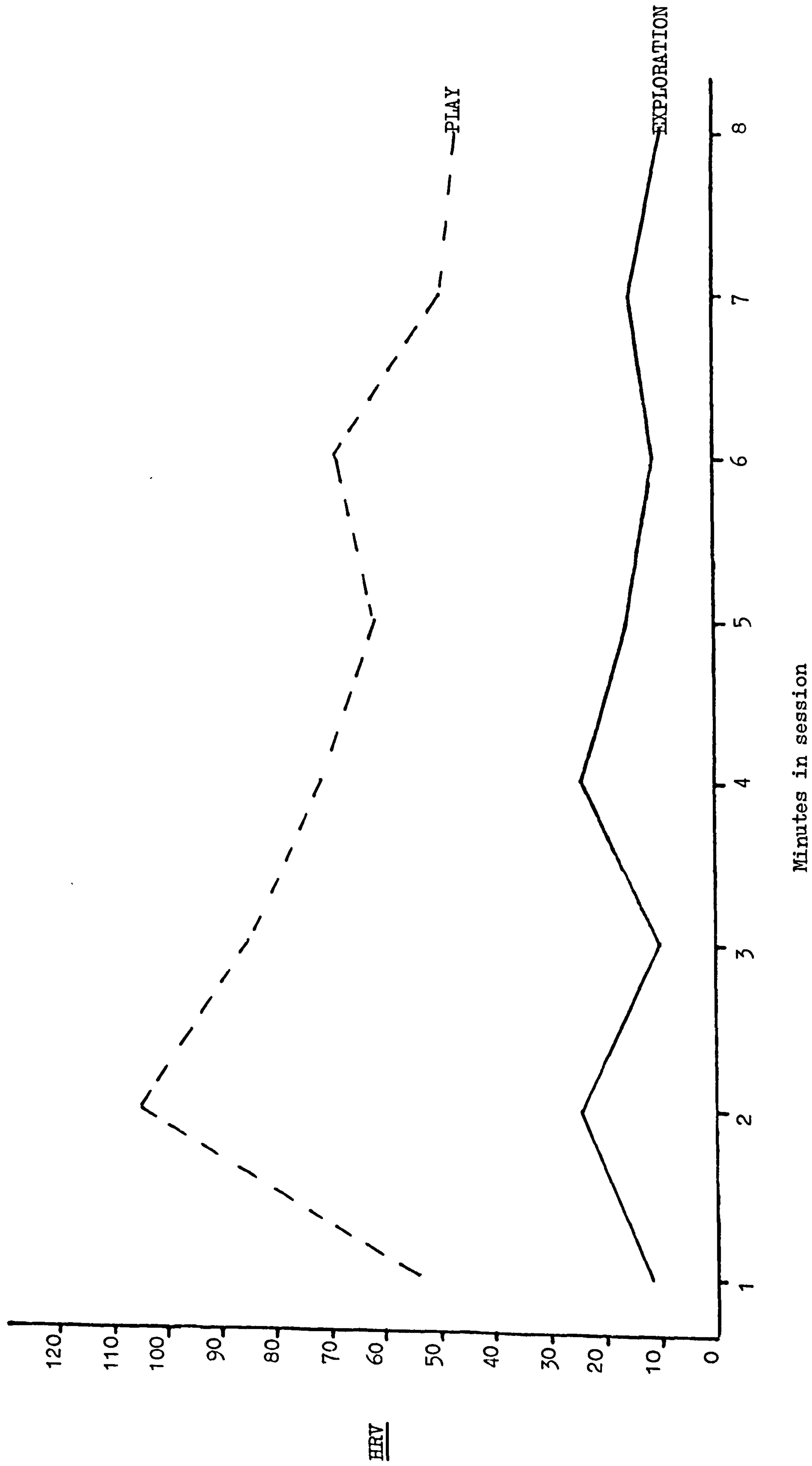


Figure 9.6 Mean HR during play (P),
Exploration (E) and Problem -
solving (P/S)

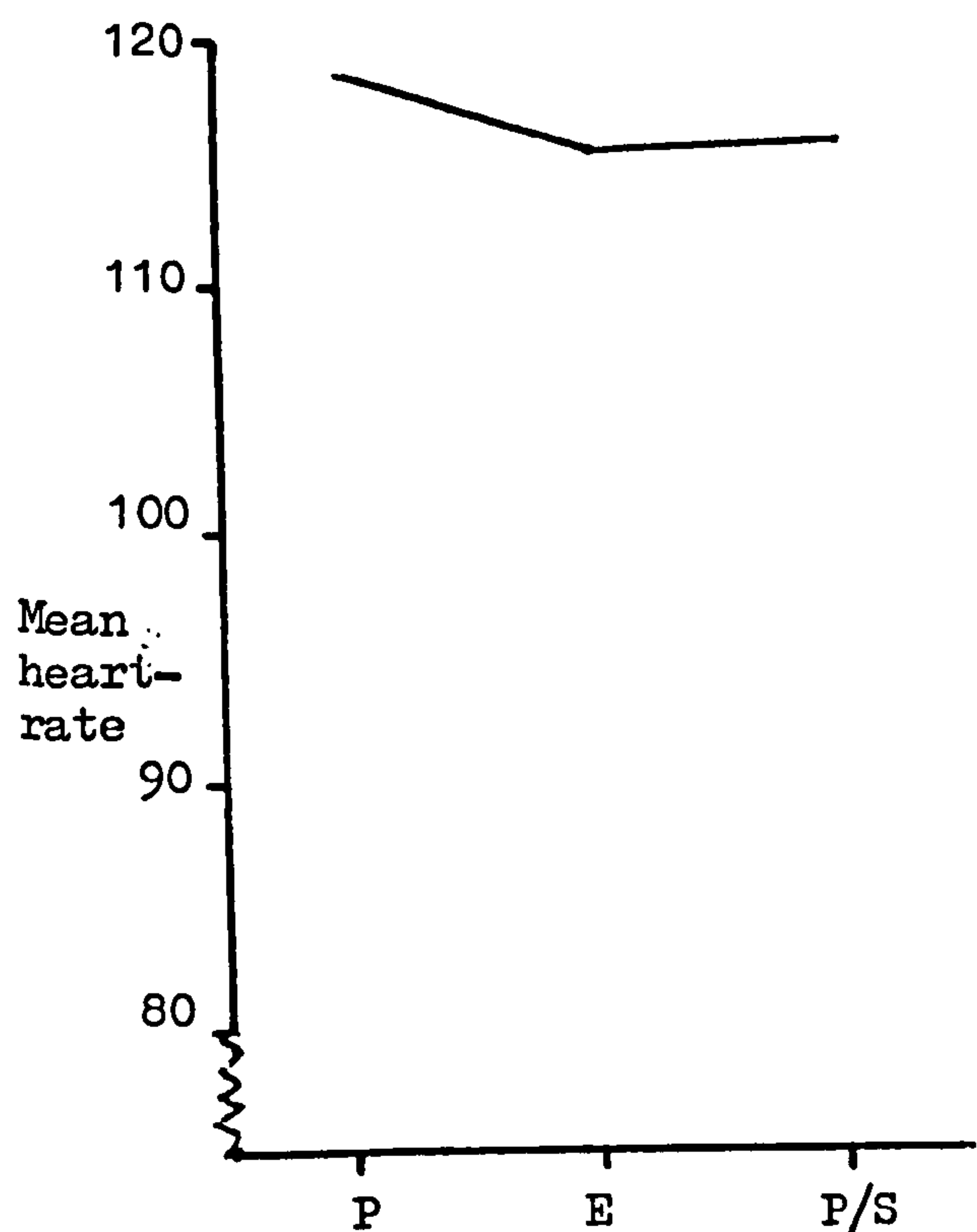


Figure 9.7 HRV during play (P),
Exploration (E) and Problem-
solving (P/S)

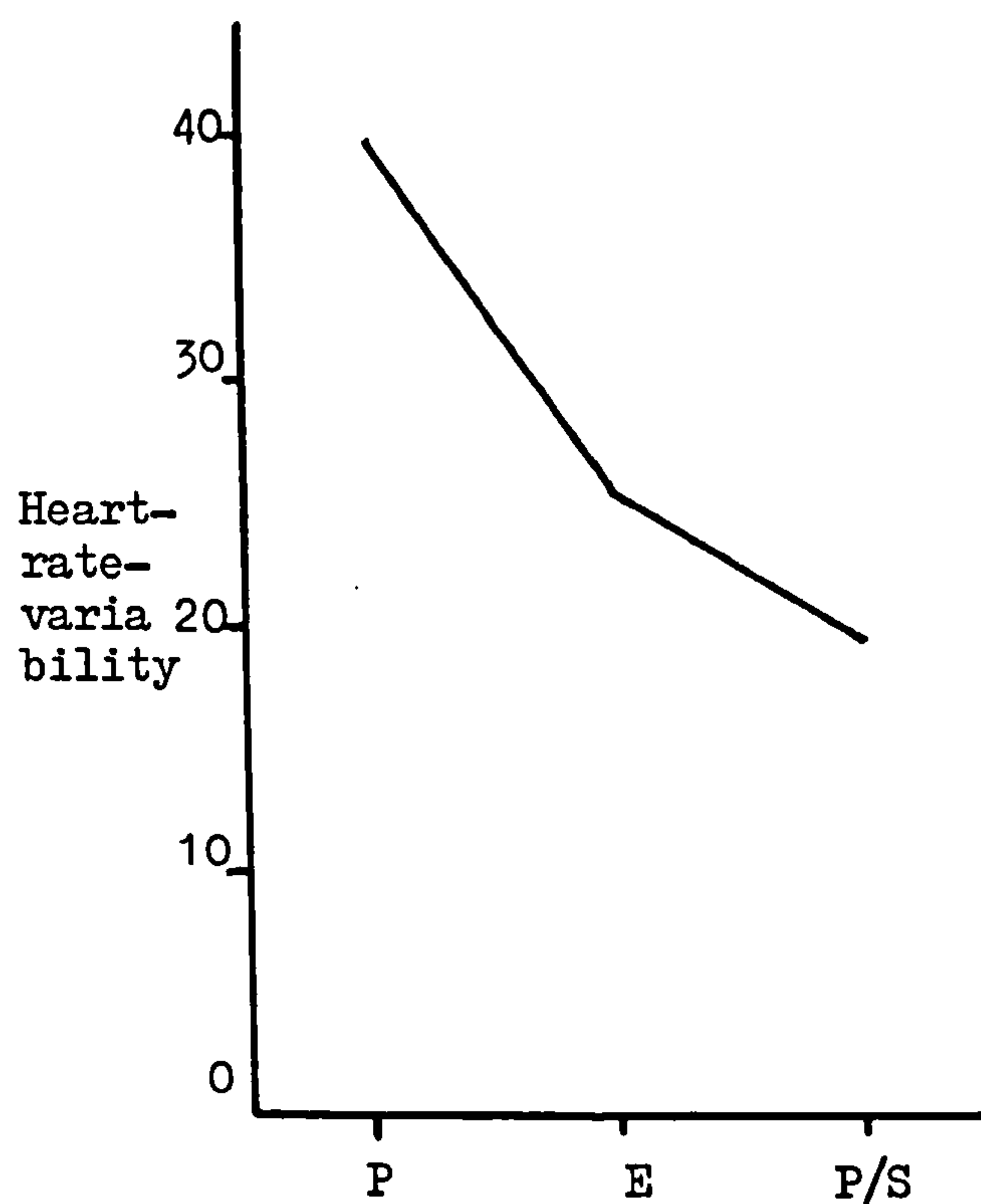


Figure 9.8 Mean HR during task (T),
day-dreaming (D) and baseline (B)
conditions.

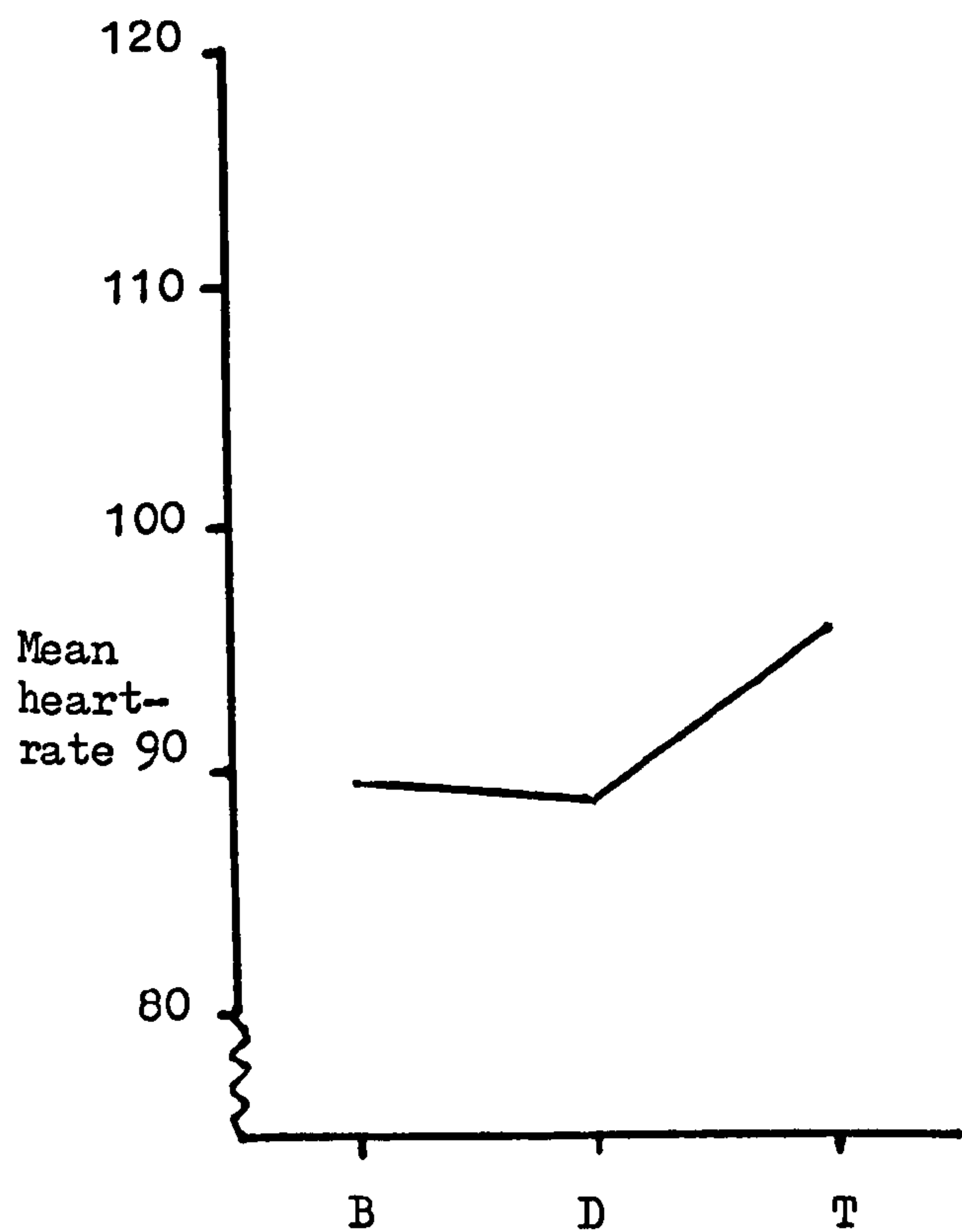
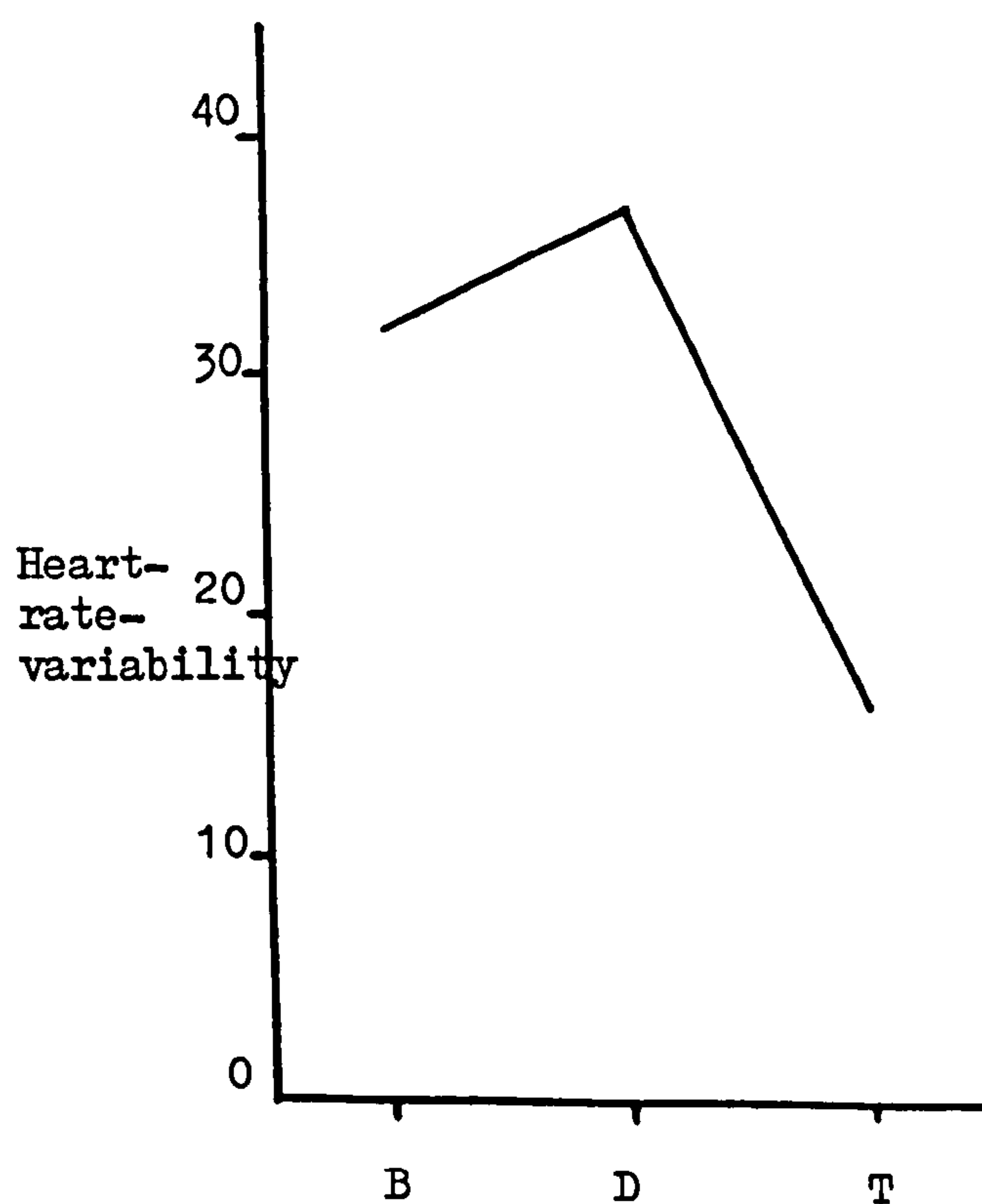


Figure 9.9 HRV during task (T),
day-dreaming (D) and baseline (B)
conditions.



CHAPTER 10

TOWARDS A MODEL OF MOTIVATION AND FUNCTION

10.1 Classification of play

The term play has been used in this thesis to describe all intrinsically motivated, non-goal oriented behaviour in young children. This description subsumes a set of 'epistemic' behaviours, which includes exploratory behaviour and imitation, and a set of 'ludic' behaviours, which includes innovative manipulative play and fantasy play. To a great extent therefore, it is similar to Hutt's (1979b) taxonomy described in Chapter 1.

It has been argued that the expression of particular play behaviours is mediated by physiological arousal mechanisms, and that levels of arousal are determined by both internal and external factors. Indeed, Hutt's taxonomy was an attempt to relate states of arousal to specific behavioural states: thus ludic behaviour correlated with a low arousal state, whereas epistemic behaviours correlated with a high arousal state. This theoretical position was supported by the studies described in Chapter 9 (Studies 9, 10, 11).

However, the simplicity of Hutt's uni-dimensional classification of play may be criticised on three main grounds: first, it does not take into account the relationship between internal and external sources of arousal; secondly, stereotyped, perseverative behaviours are reflections of high rather than low arousal; and thirdly, it attempts to distinguish between object play and symbolic play in terms of arousal

although this is probably not an appropriate distinction (Chapters 6, 7 and 8). These criticisms can be met by developing a model of play, which is based on Hutt's (1979b) original classification system, but is expressed in more than one dimension.

The behavioural states within such a model can be classified and defined in behavioural terms alone, and behavioural definitions are shown in Table 10.1. The model proposed is an attempt to provide theoretical anchorage for this classification in terms of physiological arousal, and to relate to the question 'how can a child's decision to engage in a particular activity at a given time be accounted for?'.

10.2 Proposed model of play

The terms within which a model is to be formulated are developed from motivational 'systems' theory described by McFarland (McFarland and Subly, 1975; McFarland, 1978). The essential tenet of such a model is that the set of all causal factors which determine a child's behaviour can be represented as a multi-dimensional space, the axes of which represent causal factors. Any behaviour can therefore be classified in terms of coordinates within this space, and any precise set of coordinates will uniquely determine behaviour. There may therefore be more than one set of coordinates which map on to a particular behavioural state. A sub-set of total causal factor space which determines a child's entire behavioural repertoire can be defined by referring to the 'candidate space' for a particular set of behaviours, and

this candidate space would contain only the causal factors relevant to that set of behaviours. The behaviours for which the relevant causal factors are present are then referred to as 'candidates' for the control of ongoing behaviour.

For example, the candidate space for play could be represented as a two-dimensional space with one axis corresponding to a child's endogenous arousal level and the other axis corresponding to the arousal potential (the contribution to physiological arousal made by an external stimulus (Fiske and Maddi, 1961), see Chapter 1) present in the environment. In terms of Figure 10.1, it should be evident that there are likely to be a number of motivational 'co-ordinates' which will map on to an equivalent behavioural candidate. Thus, a child with endogenous arousal level a confronted with a stimulus set of arousal potential b will explore this stimulus; similarly, the coordinates c, d would also map on to the same candidate behaviour. Individual differences in the behavioural response to a particular novel stimulus can be accounted for in terms of individual differences in endogenous arousal states, and a child's tolerance of novelty will depend on his basal arousal state: a child in a chronically high state of arousal will tend to reject any form of new information.

The proposed model distinguishes 'specific' and 'diversive' exploration in terms of the motivational states with which they are associated. Consider, for example, a child with a new toy. The expected transition from exploratory to ludic behaviour occurs as the child becomes familiar with the toy's properties,

and this transition is correlated with a decrease in arousal (Study 9). However, there comes a point at which the child is no longer able to find any more answers to the question 'what can I do with this object?' and the concomitant innovative behavioural sequences (Study 1) cease. It is in the state of causal factors when both endogenous arousal and arousal potential are low that the active seeking out of stimulation will occur. It should be noted that the endogenous state is not independent of the arousal potential, and that a continuous feedback system links the two axes: that is, as arousal potential decreases, so too does the endogenous arousal state (Kahneman, 1973).

According to McFarland (1978) the execution of behaviour predicted by such a model should be shown to maximise an organism's biological fitness since the decision processes which are entailed would have evolved through natural (Darwinian) selection. The decision for the organism, is how to change its state in the optimal manner by deploying the most appropriate behavioural strategy.

Experiments by Lacey and Lacey (1958) and Porges (1972) show that people make faster and more accurate responses when in moderate arousal states (i.e. showing high HRV), although the relationship between arousal and sustained performance is not so clear (Näätänen, 1975). Inasmuch as making a fast response to novelty can be regarded as adaptive, it can be argued that any behavioural decision should operate to optimise arousal levels towards this end. Thus, epistemic behaviour would be inherently arousal reducing,

whereas ludic activities would serve to maintain arousal at optimal levels. The temporal relationship between exploratory and ludic activity, together with the tentative evidence from Study 9, confirms the arousal reducing function of exploration and the maintenance of a steady state during ludic activities.

Problem-solving activities are included within play behaviours in the model despite the fact that they could be construed as goal-oriented. Behaviourally, this inclusion can be justified on the grounds that the child does seek out specific problem-solving activities (e.g. jig-saws), and this type of behaviour needs to be distinguished from externally demanded goals (e.g. when an adult requires a child to solve a set of arithmetic problems). Their inclusion in the sub-set of epistemic behaviours is made on the grounds that such activities are behaviourally similar to exploration, and Study 10 shows them to have similar physiological correlates.

The classification of forms of symbolic play within the proposed model relies upon the parallels which have been drawn between symbolic and manipulative play: that is, imitation is regarded as analogous to exploration whereas fantasy play is more evidently ludic. This argument is mainly sustained by the common observation (e.g. Piaget, 1951; Fein, 1975; Feitelson, 1975) that imitation precedes fantasy play (and this bears the same temporal relationship to fantasy play that specific exploration bears to ludic activity), and that imitation is essentially a learning experience ('accommodation' in Piagetian terms).

The developmental continuity between fantasy and day-dreaming (Study 8) together with the physiological similarity between ludic manipulative play and day-dreaming (Studies 9 and 10) offers further circumstantial evidence for the inclusion of symbolic play within this model.

To subsume perseverative stereotyped behaviour under a general classification of play may seem anomalous. However, whilst these behaviours are most often associated with mental handicap and autism, they are also to be seen in pre-schools: Hutt, Hutt, Tyler and Foy (1981) suggest that children playing with sand often do little more than pour sand, apparently aimlessly but persistently, from one container to another - such activity shares many of the behavioural characteristics of stereotypy. Their functional equivalence would bear further investigation; for the present, their behavioural similarities to stereotypy permit their joint inclusion within the proposed classification.

In summary, there are two major points to be made concerning the model illustrated in Figure 10.1. First, a child's decision to engage in a particular form of play is mediated by physiological responses; secondly, whatever a child's behavioural decision, one functional outcome is to maintain or restore arousal tonus. This model differs substantively from those of Berlyne (1960), Hutt (1970) or Ellis (1973) in that it proposes an arousal maintenance function for ludic activities, whereas 'specific' and 'diversive' exploratory behaviours are associated with changes in arousal.

10.3 Functions of play

The proposed model of play is given coherence by a motivational subsystem which operates to optimise an arousal function. In Chapter 9 (Studies 9, 10, and 11) it was suggested that play could be construed as adaptive only inasmuch as it fulfilled this function. Many authors, however, have argued that individual differences in children's play have long-term consequences in development and Chapters 5, 6, 7 and 8 attempted to examine some of the functional consequences of play behaviour in terms other than arousal.

Particular attention was paid to the relationship between play and learning in Study 3. It was demonstrated that specific exploration is an appropriate behavioural strategy for learning about the properties of objects, and that a child who is misled into premature ludic activity with objects will learn less about their properties than his 'exploratory' peers. The implications of this for intellectual development are nowhere more obvious than in developmental studies of children who have been deprived of much sensory stimulation in early childhood (e.g. Skeels, Updegraff, Wellman and Williams, 1938; Clarke and Clarke, 1976). But the distinction between exploratory and ludic behaviour also has applications in pre-schools: there is a clear onus on teaching staff to draw a child's attention to the salient properties of objects in a manner which will extend the learning experience. The consolidation of that experience during ludic behaviour can probably occur without much adult support.

Bruner's (1972, 1976) conception of play as innovative

behaviour which provides an opportunity to experiment with a variety of ideas without being constrained by their consequences, is borne out to some extent by the findings of Study 4. Bruner suggests that the behavioural and cognitive sequences during play permit the reorganisation of existing knowledge. This reorganisation is behaviourally manifest by the relatively unconstrained sequencing of behavioural categories (Study 1), and is alluded to by other authors (e.g. Bruner's (1972) "innovative sequences of behaviour" and Miller's (1973) "combinatorial flexibility"). In Study 4 it was shown that children who have the opportunity even for limited ludic activity of this kind are more creative in their expression of ideas concerning the uses of objects incorporated in that activity. Furthermore, children who have been engaged in such activity seem more disposed to think creatively about other issues than children who have been occupied by more task-oriented activity.

Chapter 5 explored the possibility that intervention in children's play would enhance the general development of creative and cognitive skills (as opposed to the expression of those skills in specific experimental context). Certainly there is evidence from a number of studies, including that reported in Chapter 6 (Study 6), that intervention in play does have effects on a number of skills: IQ performance, creativity, role-taking, and a range of verbal skills. The evidence that symbolic play could be closely related to conservation skills was found lacking (Study 5), but otherwise

most of the claims made for the beneficial effects of intervention in children's play appear to be substantially true. It is nonetheless unproven that the effects of any particular type of play are unique. Children who engage in very low levels of fantasy play in early childhood may still achieve high scores on creativity tests - indeed, are as likely to do so as any of their peer group (Study 8).

In the light of these negative results it is difficult to argue strongly that play has any crucial role in cognitive development.

10.4 Play and biological fitness

Sutton-Smith (1973) reported that very little play is observed in subsistence cultures: he suggested that this is indicative of the low priority that play behaviours have in the motivational hierarchy. Nonetheless, he argued that innovative ideas are developed during play, and that innovation becomes widely acceptable through play. Fagen (1976, 1977) accepted the theoretical position that "play may provide a source of increased behavioural variability, generating novel, innovative and possibly useful acts which may be propagated to other individuals by observational learning"; but "the existence of innovative potential in a population of animals capable of observational learning is no guarantee that such potential will be favoured by natural selection." (1976, p.97).

The issue of the way in which play might contribute to biological fitness can be examined against a model which

proposes values attached to innovation through play and the associated deficits which might be incurred by playing but failing to innovate. In subsistence cultures, the biological cost of play may be very high: it could, for example, result in the failure to collect adequate provision or provide adequate shelter. In more highly technologically developed cultures, however, a child is unlikely to incur any biological cost through play. Fagen (1976) described a model in which genes for 'playfulness' are initially randomly distributed throughout a population; some members of that population will incur the biological benefits of others' play through observational learning. According to the principles of population biology, a population will eventually reach a steady state in which a balance of 'players' and 'observers' will maximise the fitness of each individual within that population. And the steady state for any population will depend on both environmental and species factors.

Such a simple model offers an elegant explanation of the evolution of individual differences in play, and of the relative paucity of play in some cultures. It is made the more plausible by the identification of biological mechanisms which underlie the expression of playful behaviour.

10.5 Summary and conclusion

Berlyne (1969) wrote "...there is some justice in the view that our ignorance is the main factor that holds together the category of play....psychology would do well to give up the category of play in favour of both wider and narrower

categories of behaviour." Experimental studies of play were dogged by the imprecision of definitions, and the lack of an acceptable theoretical perspective. In this thesis, I have argued that to abandon the concept of play is to turn our backs on an important aspect of human development, and that the study of play is therefore justified. The concept of arousal, whilst not without problems, seems to offer a useful theoretical framework for its interpretation.

Studies 1 and 2 replicated one of the most important and oft-quoted experiments in the play literature (Hutt, 1966). At a behavioural level, they confirmed the distinctive qualitative properties which underlie the theoretical separation of 'exploration' and 'play': namely that exploration is characterised by serious facial expression, visuo-motor coordination, and a specific ordering of behavioural sequences; play, on the other hand, is relaxed and innovative. The mathematical analysis of these sequences demonstrated that it is possible to quantify the degree of constraint in exploration relative to play, and that the innovative nature of play sequences can be clearly illustrated by an hierarchical presentation of data. Furthermore, it was suggested that the constraint of exploratory sequences reflected the biological selection for this behaviour during evolution.

Studies 3 and 4 were designed to examine differences in function between the exploratory and ludic behaviours described in Studies 1 and 2. It was shown that whereas exploration is associated with learning about the properties

of objects, ludic behaviours appear to underlie creative and divergent cognitive processes. These studies were concerned wholly with manipulative play which is only one component of children's play and four further studies therefore examined the nature of symbolic play.

It was suggested that symbolic play could be classified on an epistemic-ludic dimension in the same way as manipulative, object play; that imitation (representational play) is analogous to exploration, and fantasy play is analogous to ludic behaviour. It was suggested that symbolic play may underlie the unique conceptual abilities of man, and that its function could therefore be expressed in terms of cognitive aspects of behaviour. However, no difference was found between children who engaged in high or low levels of fantasy play; and the effects of intervention in fantasy play were not found to be unique.

Three final studies considered the psychophysiological substrates of play and confirmed the theoretical predictions of Berlyne (1960), Hutt (1970) and Ellis (1973) that ludic behaviour is associated with lower levels of arousal than exploration and problem-solving. Furthermore, it was found that day-dreaming and ludic behaviour are correlated with similar states of psychophysiological arousal.

In this final chapter, an attempt has been made to postulate a model of play which would reflect the epistemic-ludic distinction, and would be capable of subsuming the experimental findings. It is concerned mainly with the motivational aspects of play, and suggests that these are

mediated by physiological arousal processes; the model is therefore capable of making specific predictions about the behavioural response of a child to particular situations.

In terms of function, the research reported in this thesis is able to attribute a learning function to exploratory behaviours which is in contrast to the innovative nature of ludic behaviours. However, there is no evidence that a child who disdains ludic symbolic play (i.e. fantasy play) is at any disadvantage relative to his peers in his cognitive ability.

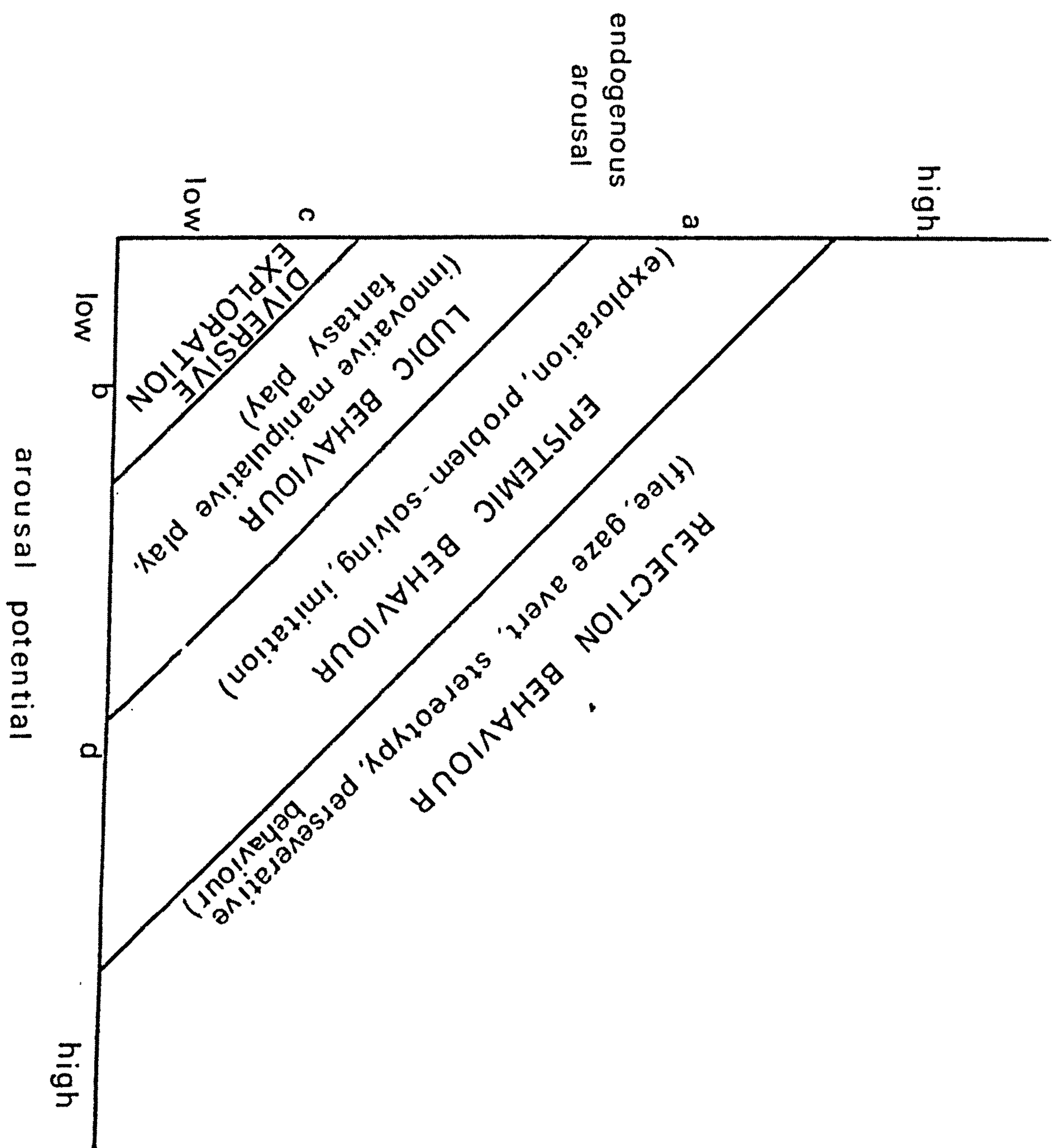
Table 10.1 Behavioural definition of play states

1. <u>Diversive exploration</u>	
Looking for activity, restless.	
Bored facial expression	
Desultory and repetitive investigation of previously ignored objects (e.g. light switches, door handles)	
2. <u>Innovative manipulative play</u>	
Occurs only in familiar environment	
Relaxed (sometimes smiling) facial expression	
Incorporation of objects in innovative behavioural sequence	
3. <u>Fantasy play</u>	
Innovative behavioural sequences incorporating imaginary characters places and events	
Use of <u>ad hoc</u> props	
4. <u>Specific exploration</u>	
Response to novel stimulus	
Intent, serious facial expression	
Visuo-motor coordination	
Constrained behavioural sequences	
5. <u>Imitation (representational play)</u>	
Behavioural reproduction of known activity	
Use of 'literal' props (replicas)	
6. <u>Perseverative behaviours</u>	
Agitated, tense facial expression	
Repetitive, intensive manipulation of familiar objects.	

LUDIC BEHAVIOURS

EPISTEMIC BEHAVIOURS

REJECTION



APPENDIX A

[illegible]

APPENDIX B**Definition of Behavioural Categories**

1. **Visual Inspection:**
Visual orientation towards the object, without any other accompanying activity.
2. **Touch/finger:**
Hands on the object but no manipulation. This and other object responses assume synchronous visual orientation unless otherwise indicated.
3. **Lever:**
Manipulation of the lever with one or both hands in the four directions while sitting or standing in front of the object.
4. **Hold + toy:**
Hand holding lever. Another toy in other hand or under arm.
5. **Manipulate + toy:**
Manipulation as in (3) whilst holding another toy.
6. **Manipulate fast:**
Self explanatory
7. **Manipulate + gesture:**
Manipulation as in (3) whilst gesticulating, e.g. waving arm, pulling faces etc.
8. **Manipulate + physical:**
Manipulation as in (3) whilst climbing, sitting astride, standing on or general gross motor movements associated with object.
9. **Manipulate + talk:**
Self explanatory
10. **Manipulate unconventionally:**
Heterogeneous category - usually operation of lever other than with hands, (e.g. a knee, elbow, head etc), or while in an unconventional position (e.g. lying flat on floor).
11. **Push/pull:**
Self explanatory
12. **Manipulate other toy:**
Self explanatory
13. **Watch something else:**
Self explanatory
14. **Run/walk:**
Gross locomotor activity not associated with object.

Appendix C

Script for conservation and class inclusion testing

(Children to be seen individually, and to be familiar with experimenter).

1. Conservation of solid

E takes 2 balls of playdoh from equipment box on floor and places them on table in front of C. "Is there the same amount of playdoh in each of these balls?"

If no: "Which one shall I put some more on to, to make them the same?"....

"Are they the same now?" (If no, repeat until C satisfied).

If yes: Roll one ball into sausage.

E: "Does this one" (point to sausage) "have more, less, or the same amount of playdoh as this one?" (point to ball). SCORE

E: "Why do you think so?" SCORE

Roll sausage back in to ball.

E: "Is there the same amount of playdoh in each ball?"

If no: E: "Let's make them the same again. Here's some playdoh. You do it this time, and tell me when you've made them the same." (cont.)

If yes: E: "Now you roll this one into a sausage". "Does this one have more, less, or the same amount of playdoh as this one" (pointing).

"Can you tell me why?"

If score different from above, use higher score.

2. Conservation of liquid

Place tall gas jar (G) and 2 jam jars (J) on table; pour the same amount of water in each J.

E: "Is there the same amount of pink water in each jar?"

If no: "Which one shall I put some more in to make them the same?"

"Are they the same now?" (cont. until C satisfied).

If yes: pour water from J into G.

E: "Does this one" point to G "have more, less, or the same amount of pink

water as this one?" point to J. SCORE

E: "Why do you think so?" SCORE

Pour water from G back to J.

E: "Is there the same amount of pink water in each jar?"

If no E: "Let's make them the same. Here's the jug: you do it this time.

Tell me when you've made them the same."

E: "Now put the pink water in this jar" (point to J) "into this tall jar" (point to G).

"Does this one" point to G "have more, less, or the same amount of pink water as this one?" point to J. SCORE

"Why do you think so?" SCORE

If score different from above, use higher score.

3. Class inclusion

Put 7 blocks on table: 5 red, 2 yellow.

E: "What are these things called?"

"Are they all blocks?"

"Which colours can you see?" (point to each block and name colour)

"Are there more red blocks or more yellow blocks?" SCORE

Can you tell me why?

Repeat using counters.

PLAYFULNESS QUESTIONNAIRE

1978.

Name of parent:

Name of child:

Age of child:

Date of test:

This questionnaire is concerned with your child's behaviour before he began full-time primary education, i.e. at age 3 - 5 years.

1. How often did engage in spontaneous physical movement and activity during play? (This behaviour would include skipping, hopping, jumping and other rhythmic movements of the whole body or parts of the body like arms, legs or head, which could be judged as a fairly clear indication of exuberance).

very often often occasionally rarely very rarely
.....X.....X.....X.....X.....X.....

2. How often did show joy in or during play activities?

very often often occasionally rarely very rarely
.....X.....X.....X.....X.....X.....

3. How often did show a sense of humour during play?

very often often occasionally rarely very rarely
.....X.....X.....X.....X.....X.....

4. Did engage in spontaneous make-believe play?

very often often occasionally rarely very rarely
.....X.....X.....X.....X.....X.....

5. What degree of imagination did show in his/her play?

very high high moderate some very low
.....X.....X.....X.....X.....X.....

6. When playing alone, what were favourite pastimes?

7. When playing with other children what were favourite games?

8. If you ever went on car journeys or walks, were there any games you played together as a family?

9. Did ever have an imaginary companion? YES/NO.

10. How would you describe temperament at age 4 - 5?

placid	easy going	shows extreme emotion under provocation	occasional unprovoked tantrums	volatile
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.....X.....X.....X.....X.....X.....

11. What were sleeping patterns?

Rising - early/normal/late

Afternoon sleep - Yes/No

Bed - early/normal/late

12. To what extent do you think play was influenced by T.V.?

substantially	most	some	very little	not at all
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.....X.....X.....X.....X.....X.....

13. Did have a favourite toy? YES/NO

a). What.

b). Why favourite.

APPENDIX E

The use of heart-rate-variability as a measure of arousal

Many studies have shown changes in heart-rate (HR) to be a singularly sensitive measure of attention and arousal in infancy and early childhood (see Campos, 1976). More than a decade ago, Lacey (1967) observed that heart-rate-variability (HRV), i.e. the fluctuation of HR from beat-to-beat, is also easily inhibited by attention. But this aspect of cardio-vascular function has hitherto received little attention from developmental psychologists or from psychophysiologicalists. Studies by Porges and his colleagues have been an exception and these showed that in both adults (Porges and Raskin, 1969; Porges, 1972) and newborn infants (Porges, Arnold and Forbes, 1973; Porges, Stamps and Walter, 1974) HRV was suppressed by attention, a finding which led Porges to propose a two-component hypothesis of attention. The first component is the phasic, directional response determined by attributes of the stimulus and the second, the tonic suppression of HRV accompanying attention (Porges, 1972; 1976). This latter component has recently received particular consideration in relation to skilled operations (see Rolfe, 1973; Boyce, 1974) where suppression of HRV is found to be a sensitive index of task involvement and workload, the degree of suppression being directly proportional to the mental load. This relationship is used in assigning the task demands of many flight, vigilance and industrial operations (Kalsbeek, 1971; Kalsbeek and Ettema, 1973; Mulder and Mulder-Hajonides, 1973; Rohmert, Laurig, Phillip and Luczak, 1973).

In an analysis of different measures of HRV, Luczak and Laurig (1974) have demonstrated that the relatively simple measure of variance (computed such that $= \frac{\sum (x - \bar{x})^2}{N - 1}$) of HR can be a sensitive reflection

of attention. Moreover, in children where beat-to-beat fluctuations are of a greater magnitude than in adults, variance better reflects these changes than the number of turns.

Differences in heart-rate variability has also been shown to correlate with different behavioural states in both normal and autistic children (Hutt, Forrest and Richer, 1975). It seemed worthwhile therefore, to pursue its utility in the present context.

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